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PRELIMINARY (30%) DESIGN SUBMITTAL / PRE-DESIGN INVESTIGATION WORK PLAN

Operable Unit 2 North Penn Area 5 Superfund Site
Unilateral Administrative Order (UAO)
Docket No. CERCLA-03-2012-0205DC

Submitted on Behalf of

Stabilus, Inc.
1201 Tulip Drive
Gastonia, NC 28052

Prepared by

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Project Number PH0013

18 March 2013

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18 March 2013

Via Email and Federal Express

Ms. Sharon Fang (3H521), Remedial Project Manager
U.S. Environmental Protection Agency – Region III
1650 Arch Street
Philadelphia, PA 19103

Subject: **Preliminary (30%) Design Submittal /**
Pre-Design Investigation Work Plan (PDI Work Plan)
Operable Unit 2 North Penn Area 5 Superfund Site
Unilateral Administrative Order (UAO)
Docket No. CERCLA-03-2012-0205DC

Dear Ms. Fang:

On behalf of Stabilus, Inc., please find enclosed three (3) copies of the Preliminary (30%) Design Submittal / Pre-Design Investigation Work Plan (PDI Work Plan) dated 18 March 2013 to fulfill the requirements of Section VI Paragraph 25.b of the Unilateral Administrative Order (UAO) Docket No. CERCLA-03-2012-0205DC dated 26 June 2012, for the interim remedy for Operable Unit 2 (OU2) of the North Penn Area 5 Superfund Site. If you have any questions, please do not hesitate to contact me.

Sincerely,

Derek W. Tomlinson, P.E.
Project Coordinator

Attachment: PDI Work Plan dated 18 March 2013

cc: Tim Cherry, PADEP *(via email & 1 hardcopy first class mail)*
M. Joel Bolstein, FoxRothschild
Chris Voci, Geosyntec
File: PH0013

CERTIFICATION

Except as provided below, I certify that the information contained in or accompanying this Preliminary (30%) Design Submittal / Pre-Design Investigation (PDI) Work Plan (PDI Work Plan) is true, accurate, and complete.

As to those portions of this PDI Work Plan for which I cannot personally verify their accuracy, I certify under penalty of law that this PDI Work Plan and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____

Name: Craig Postiech

Company: Stabilus, Inc.

Title: CFO

Date: 3.15.13

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LIST OF ACRONYMS

cDCE	cis-1,2-dichloroethene; cis-1,2-dichloroethylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCs	chemicals of concern
CSIA	compound specific isotopes analysis
CSM	conceptual site model
Dhb	Dehalobacter
Dhc	dehalococcoides
DHG	dissolved hydrocarbon gases
DO	dissolved oxygen
EISB	enhanced in situ bioaugmentation
EVO	emulsified vegetable oil
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	geographic information system
GPS	Global Positioning System
HASP	Health and Safety Plan
MCL	maximum contaminant level
µg/L	microgram per liter
MIP	membrane interface probe
MS/MSD	matrix spike/matrix spike duplicate
NELAP	National Accredited Laboratory Accreditation Program
NP5	North Penn Area 5
NPL	National Priorities List
NPWA	North Penn Water Authority
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OU	operable unit
OU1	Operable Unit 1

LIST OF ACRONYMS
(continued)

OU2	Operable Unit 2
OU3	Operable Unit 3
PADEP	Pennsylvania Department of Environmental Protection
PPC	Preparedness, Prevention and Contingency
PCE	tetrachloroethene; tetrachloroethylene; perchloroethene
PDI	pre-design investigation
PID	photo-ionization detector
PPE	protective personal equipment
PRP	Potential Responsible Party
QA	quality assurance
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance and quality control
QC	quality control
RA	Remedial Action
RAO	Remedial Action Objectives
RD	Remedial Design
RD/RA	Remedial Design and Remedial Action
RDWP	Remedial Design Work Plan
redox	oxidation-reduction
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RPM	Remediation Project Manager
SMP	Site Management Plan
SOP	standard operating procedure
SPCC	Spill Prevention, Control and Countermeasure
TCE	trichloroethene, trichloroethylene
TEA	terminal electron acceptor

LIST OF ACRONYMS
(continued)

UAO	Unilateral Administrative Order
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VC	vinyl chloride
vcrA	vinyl chloride reductase
VOCs	volatile organic compounds
WMP	Waste Management Plan

1. INTRODUCTION

This Preliminary (30%) Design Submittal / Pre-Design Investigation (PDI) Work Plan (PDI Work Plan) was prepared by Geosyntec Consultants, Inc. (Geosyntec) on behalf of Stabilus, Inc. (Stabilus), a named Respondent to the Unilateral Administrative Order (UAO) Docket No. CERCLA-03-2012-0205DC dated 26 June 2012 (USEPA, 2012), for the interim remedy selected by the United States Environmental Protection Agency (USEPA) for Operable Unit 2 (OU2) of the North Penn Area 5 Superfund Site in Hatfield and New Britain Townships (aka, Colmar), Montgomery and Bucks Counties, Pennsylvania (the "Site" or "NP5 Site", Figures 1 and 2).

This PDI Work Plan is being submitted to the USEPA pursuant to Section VI Paragraph 25.b of the UAO and as detailed within the 29 January 2013 Remedial Design Work Plan (RDWP; Geosyntec, 2013). The UAO was issued for the completion of the Remedial Design (RD) and Remedial Action (RA) to implement the 7 September 2011 Record of Decision (Interim ROD) for the enhanced *in situ* bioaugmentation (EISB; USEPA, 2011) interim remedy. The USEPA selected the EISB remedy to address elevated levels of volatile organic compounds (VOCs), which have been historically detected in the OU2 overburden groundwater.

As outlined in the RDWP, this Preliminary (30%) Design Submittal (aka, PDI Work Plan) is the first of the four submittals of the detailed design sequence and focuses on the collection of PDI data needs. The PDI Work Plan incorporates the elements of the Design Sampling and Analysis Plan including the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP); Site Management Plan (SMP); Health and Safety Plan (HASP); Waste Management Plan (WMP); and Spill Prevention Contingency Countermeasures (SPCC) Plan. The PDI Work Plan also provides the groundwater interim remedy treatment area delineation approach and EISB treatability study plan.

1.1 Pre-Design Investigation Objectives

The USEPA established Remedial Action Objectives (RAOs) in the OU2 Interim ROD. The RAOs for the interim OU2 EISB remedy are as follows:

- Reduce a source of contamination by restoring groundwater quality in the treatment area of the overburden to maximum contaminant levels (MCLs) established under the Safe Drinking Water Act;
- Prevent or minimize further migration of contaminants from the overburden; and
- Prevent future exposure to contaminated groundwater at concentrations above MCLs.

The primary objectives of the RD are to gather supplemental information at OU2, perform engineering evaluations to support the preparation of construction drawings and specifications to achieve the RAOs through EISB, and to meet the other performance standards and requirements set forth in the Interim ROD and UAO, and summarized within the RDWP (see RDWP

Section 1.4). The RD will be developed with these RAOs and remedy performance standards as the goal of the implemented RA.

An objective of the PDI is to provide updated data relative to the current nature and extent of VOCs in the OU2 overburden groundwater. These data will be used to define the EISB treatment zone, to identify locations of the EISB injection and to aid in the design of the performance monitoring well network.

Environmental Resources Management, Inc. (ERM) completed a bioaugmentation bench-scale treatability study which concluded that EISB was a viable in situ remedial approach for OU2 (ERM, 2004). The ROD requires that a "*second bench-scale study be conducted as part of the design of the interim remedy to determine the best mix of nutrients and microbial cultures required to optimize biodegradation processes and achieve performance standards in-situ".* Data to be collected during the PDI to support the EISB design include the composition of the VOC contaminant suite and groundwater redox and biogeochemical conditions in the OU2 groundwater. These data are necessary to select the appropriate biostimulant, bioaugmentation culture, and (potentially) pH buffering amendments.

1.2 Report Organization

This PDI Work Plan is organized as follows:

- **Section 2**: Background Information. An overview of the OU2 layout, geology, hydrogeology, geology, regulatory history, and historic Site conditions;
- **Section 3**: Pre-Design Data Gaps. A summary of the information needed to aid in the RD for the EISB remedy and to aid in development of the overburden groundwater conceptual site model (CSM);
- **Section 4**: Site Management Plan. Describes the management of the RD to complete the work at the Site and includes the HASP, SPCC Plan, and WMP;
- **Section 5**: Field Sampling Plan. Provides the details of the FSP specific to the overburden groundwater delineation field activities including the sampling locations and procedures;
- **Section 6**: EISB Treatability Study Plan. Provides the details for the EISB treatability study including number and quantity of microcosms, testing to be completed and anticipated duration;
- **Section 7**: Quality Assurance and Quality Control. Summarizes the procedures and methods to be implemented for the PDI activities for the Quality Assurance Project Plan (QAPP); and
- **Section 8**: References.

2. BACKGROUND INFORMATION

Detailed information on the Site history is presented in Section III of the UAO, Section II of the ROD, and Section II of the Interim ROD (USEPA, 2011, 2004, and 2012). Background information relative to the OU2 interim remedy is discussed below.

2.1 Site Description

The Site layout and setting, geology and hydrogeology are summarized below.

2.1.1 Layout and Setting

The NP5 Site is located within Hatfield and New Britain Townships, in Montgomery and Bucks Counties, Pennsylvania (Figure 1). NP5 encompasses an area of approximately five square-miles that is generally bounded by Richardson Road to the southeast, Bethlehem Pike (Route 309) to the west, Trewigtown Road to the northwest and Schoolhouse Road to the east (Figure 2). As noted, the focus of this PDI Work Plan is the area located on the former Stabilus property and the former BAE Systems, Inc. and BAE Systems Information and Electronic Systems Integration, Inc. (BAE) property shown as the OU2 area on Figure 3.

Although the NP5 Site is within an area comprised of commercial and industrial businesses, residences, undeveloped woodland properties, parkland and farmland, the area where the interim remedy is to be performed at OU2 is entirely within the former Stabilus and former BAE industrial properties. The topography within OU2 slopes gently from the northwest and southeast toward the West Branch of the Neshaminy Creek. Large portions of OU2 are relatively flat-lying from grading associated with construction or agriculture. The major surface water bodies in the vicinity of OU2 include the West Branch of the Neshaminy Creek, its Western and Eastern tributaries, and an unnamed tributary to the Neshaminy Creek as shown on Figures 1 and 2.

2.1.2 Geology

The NP5 Site is located within the Triassic Lowlands section of the Piedmont Physiographic Province and is underlain by sedimentary rocks of the Brunswick and Lockatong Formations of the Newark Supergroup. Bedding in the Newark Supergoup generally strikes northeast and dips to the northwest. These formations have been well studied by the United States Geological Survey (USGS) and others through investigations of regional groundwater contamination over the last three decades. The Brunswick and Lockatong Formations are part of a homoclinal structure that strikes northeast to southwest and dips from approximately 20° to 30° to northwest (Bird and Conger, 2002; Riser and Bird, 2003; Bird, 2006). The lower beds of the Brunswick Formation consist of red to reddish brown and gray to greenish-gray mudstones, clay, and mud-shales. The bedding is irregular and wavy. The Lockatong Formation rocks are thinly-bedded and evenly-bedded shales and siltstone that are medium to dark gray and olive to greenish-gray.

Bedrock beneath the Site is mantled with an overburden (regolith) comprised of silt, clay, and some sand. The regolith was formed through the gradational weathering of the underlying sedimentary bedrock. The overburden is typically 10 to 40 feet thick and generally more competent and less permeable with depth. The upper portion of the overburden is typically unsaturated; however saturated conditions do occur within the overburden. Generally, the base of the overburden and the thicker sections of overburden are perennially saturated during normal precipitation conditions. The overburden groundwater within OU2 is the subject unit of the PDI and associated EISB remedy.

Site-specific investigations confirm that the bedrock surface beneath the OU2 overburden forms a trough or shallow basin. This feature is significant with respect to the overburden thickness and the resulting distribution of VOCs in saturated soils. Figure 4 presents a visualization of the bedrock topography prepared as part of USEPA's investigation data from 1998 and 2003 using the depth to the top of bedrock measured during subsurface soil boring investigations within the overburden. The alignment of the bedrock trough trends along bedrock strike (shown within the blue dashed lines on Figure 5). Highs in bedrock surface elevation straddle the bedrock trough (shown as red dashed outlines on Figure 5). A high in bedrock surface elevation may also be present along the line of the bedrock trough southwest of the former Pond Area (also shown as red dashed outline on Figure 5).

2.1.3 Hydrogeology

Groundwater originates from infiltration of local precipitation through the overburden into the bedrock fracture network, and eventually discharges to surface water features (i.e., streams, rivers). The overburden is largely unsaturated, but does contain groundwater at its base above the bedrock, especially during periods of higher seasonal recharge. The thicker sections of overburden, such as those in the vicinity of the former BAE and former Stabilus properties, have historically contained a saturated zone of approximately 3 to 10 feet in thickness year-round. The depth to groundwater in this overburden unit has historically ranged from 4 to 10 feet below grade.

The groundwater flow direction in the OU2 overburden unit is locally variable, but overall is vertical down to the top of the bedrock. Factors influencing the overburden groundwater flow direction include the permeability of the regolith and the presence of relict rock fabric (former bedrock bedding planes and joints) in the weathered bedrock portions of the overburden. OU2 overburden groundwater may flow horizontally along the interface between the bedrock and the overburden and would thus follow the topography of the bedrock surface until it drains under gravity. Once in the bedrock fracture system, groundwater flows through the vertical joints and horizontal fractures in the shale and siltstone bedrock. Groundwater may occur under confined or unconfined conditions within bedrock depending upon the thickness of the overlying overburden.

The bedrock has low primary porosity, but moderate to high secondary porosity via a network of fractures, bedding-planes, and high-angle joints throughout which groundwater exists and can flow vertically and horizontally. Most of the water-bearing fractures are located within the upper 80 to 100 feet of the surface. The frequency of bedrock fractures generally decreases with depth. The shallow portion of the bedrock aquifer consists of a fracture zone that exists at depths of approximately 90 to 100 feet below the surface. The depth to groundwater in this aquifer has historically varied from 10 to 30 feet below grade. Groundwater flow in this aquifer has been influenced by the local bedrock structure and in response to gradients induced by historic regional pumping. Historically, groundwater in this portion of the aquifer generally flows in a direction similar to topographic gradient generally towards the West Branch Neshaminy Creek and its tributaries. Groundwater flow north of the West Branch Neshaminy Creek is generally southeasterly, and groundwater flow south of the creek is generally northeasterly. Groundwater in this portion of the aquifer eventually discharges to the surface streams or provides recharge to the deeper aquifer system.

The deeper portion of the bedrock aquifer consists of the fracture zone greater than 100 feet below the surface to an approximate maximum depth of 500 feet. The geology and groundwater flow conditions of the deeper portion of the bedrock aquifer are similar to that of the shallower, albeit with fewer water-bearing fractures.

2.2 Overview of OU2 Regulatory History

NP5 was first identified in 1979 with the detection of VOCs in groundwater from North Penn Water Authority (NPWA) supply well NP-21. In 1986, USEPA completed an assessment of contamination in the NP5 area. Based on the results of the 1986 assessment, USEPA proposed the Site to be listed on the National Priorities List (NPL) on 22 January 1987. On 31 March 1989, USEPA finalized the listing of the Site on the NPL. For NP5, three primary areas of groundwater contamination were identified and defined as separate and distinct operable units (OUs). Per the UAO, the general location of OU1, OU2 and OU3 are described as follows:

- **OU1:** located at and in the vicinity of the property located at 305 Richardson Road in Colmar, Pennsylvania, formerly owned and operated by BAE, and currently owned and operated by Sensor and Antenna Systems Lansdale, Inc. (Sensor) with portions that may extend to other properties. EPA identified BAE as the sole responsible party at OU1;
- **OU2:** located at and in the vicinity of three industrial properties, including the industrial property located at 92 County Line Road in Colmar, Pennsylvania, currently operated by Constantia Colmar, Inc. (Constantia) and formerly operated by Stabilus, the industrial property located at 305 Richardson Road, formerly owned and operated by BAE, and the industrial property located at 4379 County Line Road owned and operated by Kema-Powertest, with portions that may extend to other properties. EPA issued general or special notice letters for OU2 to Stabilus, BAE,

Honeywell, Inc., Kema-Powertest, ZF Sachs Automotive of America, Inc., Constantia, County Line Land Limited, and County Line Land Corporation; and

- **OU3:** located in the vicinity of Advance Lane and Enterprise Lane in Colmar, Pennsylvania. EPA identified no potential responsible parties (PRPs) for OU3.

USEPA initiated a fund-lead Remedial Investigation and Feasibility Study (RI/FS) in 1998, under which the USEPA studied a five square-mile area that included properties associated with eight commercial businesses. The RI revealed that trichloroethene (TCE) and related VOCs are present in the groundwater at each OU (USEPA, 2002a, 2002b, 2002c, and 2003).

In 2002, USEPA issued a proposed remedial action plan (PRAP) setting forth its preferred remedy for each OU at the Site (USEPA, 2002d). After reviewing the extensive comments submitted during the public comment period, USEPA decided to reassess the preferred remedy for OU2. In June 2004, the USEPA issued a ROD for OU1 and OU3 (USEPA, 2004) to conduct in situ chemical oxidation (ISCO).

USEPA issued a revised PRAP for interim remedial action at OU2 on 15 September 2008 (Interim PRAP; USEPA, 2008a). The Interim PRAP presented EISB as the interim remedial action for the overburden within OU2 at the former Stabilus property and the former BAE property (Figure 3). The decision by USEPA on the selection of EISB is embodied in the Interim ROD (USEPA, 2011).

The execution of the RD/RA has been required with the issuance of the UAO on 26 June 2012. The RDWP was approved by USEPA on 16 January 2013 (USEPA, 2013; Geosyntec, 2013).

2.3 Site History

The Site history is well documented within the RI/FS (USEPA, 2002a and 2002b); Supplemental I RI/FS (USEPA, 2002c), Supplemental II RI/FS (USEPA, 2003), PRAP, (USEPA, 2002d), ROD (USEPA, 2004), Interim PRAP (USEPA, 2008a), Interim ROD (USEPA, 2011), and UAO (USEPA, 2012). Specific to the OU2 overburden the two affected properties are the former Stabilus property and the former BAE property. A summary of the ownership history and operations for these two properties follows (USEPA, 2011 and 2012):

- **Former Stabilus Property:** The former Stabilus property encompasses an area of approximately 11 acres. From 1979 to 1998, Stabilus (formerly Stabilus/Gas Springs Company) manufactured gas pistons or shock absorber type "springs" utilized in automobile hatch-backs, gates and trunks. From 1953 to 1979, approximately 4 acres of the southern portion of the property, which is an area included in the interim remedy for OU2, was owned by Tracor Aerospace Systems, Inc./American Electronic Laboratory, the predecessor to BAE. Constantia Colmar Group, formerly part of H&N Packaging, Inc., has operated on the property since 1999; and

- **Former BAE Property:** The former BAE property is a 67-acre property consisting of an electronics manufacturing and testing facility that began operations in 1953. From 1953 to 2008, the property was owned and operated by BAE Systems Information and Electronics Systems, Inc., and is formerly known as Marconi Aerospace Electronic Systems, Inc., Tracor Aerospace Systems, Inc., and American Electronics Laboratory. Historically, the operations included degreasing, anodizing, and nickel, copper, tin, and lead plating. Several buildings on the Site contained operations, which included a plating shop and a plating effluent waste treatment facility and product testing. Since February 2008, Sensor has owned the property.

2.4 Historic Site Conditions

Specific to the OU2 overburden, VOCs were detected in overburden groundwater beneath the former Stabilus property and the former BAE property as presented in the Supplemental II RI/FS (USEPA, 2003) and shown on Figure 3. The 2003 USEPA investigation identified two areas of observed elevated levels of TCE; one near the loading dock of the former Stabilus property; and the other located within the former BAE property near W-4 and RI-31. The suspected source of TCE identified near the former Stabilus property loading dock has been attributed to a spill caused by Baron Blakeslee, Inc., later Honeywell, which is identified in Section III Paragraph 9.e of the Findings of Fact in the UAO.

Based on a review of the public records for NP5 and as noted in the USEPA-prepared documents, (including the Responsiveness Summary issued by USEPA with the Interim ROD in September 2011 [USEPA, 2011]) USEPA has not identified a specific source for the elevated level of TCE in the overburden on the former BAE property. An objective of the PDI described herein is to resolve the nature and extent of groundwater contamination at OU2, including possible sources heretofore unidentified within the OU2 overburden groundwater. As noted in public comments to the ROD, PRAP, Interim ROD and USEPA Responsiveness Summary, these unidentified sources may include but not limited to areas described as the Sewer Area and Pond Area identified within the RI/FS documents (USEPA, 2002a, 2002b, 2002c, 2000d, 2003, 2008a, and 2011). The Sewer Area and Pond Area, as well as the Loading Dock Area, are within the bedrock trough discussed previously in Section 2.4.1, and are shown in relation to these overburden features on Figure 6.

3. PRE-DESIGN DATA OBJECTIVES

A well-resolved overburden CSM that incorporates the historic soil investigation results and present-day groundwater quality data is required for the RD. Several soil and groundwater investigations and sampling events have been conducted through the RI/FS process (USEPA, 2002a, 2002b, 2002c, and 2003). The data collected over the Site investigation history and the groundwater quality data to be collected during the PDI will be synthesized into a comprehensive overburden CSM as part of the PDI to represent the nature, extent, fate and transport of VOCs to support the OU2 EISB remedy design.

3.1 Overburden Groundwater VOC Nature and Extent

The delineation of VOCs, specifically TCE and related parent and daughter products (i.e. tetrachloroethene [PCE], cis-1,2-dichloroethene [cDCE], vinyl chloride [VC] and ethene.), in the overburden groundwater is a stated objective of the RI/FS (USEPA, 2002a and 2002b) and related Supplemental I and II RI/FS (USEPA, 2002c and 2003). Geosyntec reviewed data and findings from the following investigations to develop the PDI scope to fulfill the overburden groundwater delineation objective:

- 1998 USEPA overburden groundwater and soil investigation (USEPA, 2002a);
- 2001 USEPA membrane interface probe (MIP) overburden investigation (USEPA, 2002b);
- 2003 USEPA overburden groundwater investigation (USEPA, 2003); and
- 2005 BAE overburden groundwater and soil investigation (SEI, 2005).

Appendix A presents a series of TCE isoconcentration maps that represent the findings of the aforementioned groundwater investigations and identify two distinct overburden areas of elevated TCE groundwater concentration in general alignment with bedrock strike. A third elevated TCE groundwater zone is suggested by the data and may also represent a separate zone of contamination. The distribution of TCE in overburden groundwater within OU2 appears to follow the topography of the bedrock surface. Figure 6 presents the inferred bedrock trough boundary and TCE isoconcentration contours interpreted by the USEPA from Direct Push sampling conducted in May 2003 and presented in the Supplemental II RI/FS (USEPA, 2003). Together, these data suggest that the OU2 overburden groundwater TCE plume is largely contained within the bedrock trough.

Nearly a decade has passed since the last overburden groundwater sampling event was performed. OU2 groundwater VOC concentrations were compared over the period from 1998 to 2003 and indicated that groundwater TCE concentrations were decreasing under natural conditions (ERM, 2003). This is further supported by the demonstration of monitored natural attenuation of VOCs for OU1 (EAI, 2010). The PDI sampling approach has been developed to

assess the present-day VOC conditions and to better understand the nature of TCE source(s) associated with the OU2 overburden groundwater plume as described below.

3.2 PDI Sampling Design and Rationale

The PDI sampling design and rationale was developed to update and further delineate the OU2 overburden groundwater VOC plume and to collect design data for the EISB remedy. As shown on Figure 7, the current overburden groundwater conditions will be assessed at a total of 38 locations in a series of transects oriented perpendicular to the centerline of the inferred VOC plume. All locations will be completed with a pneumatic hammering direct push rig. At ten of the sampling locations (TW01 to TW10) temporary monitoring wells will be constructed in a transect oriented along the centerline of the 38 proposed groundwater sampling locations shown on Figure 7. Grab groundwater samples will be collected using a HydroPunch™ or similar direct-push method from the remaining 28 locations (TW11 to TW38) (Figure 7). This PDI OU2 overburden groundwater sampling approach will provide data to evaluate the current spatial distribution of overburden groundwater VOCs and potential VOC source(s). In addition to the OU2 overburden groundwater sampling, soil samples will be collected at the ten temporary monitoring well locations to evaluate the potential for VOC sorption into the soil and/or weathered bedrock matrix shown as SB01 to SB10 on Figure 7. The selection of the soil sampling intervals within the ten temporary monitoring well soil borings will be made in the field based on photoionization detector (PID) responses from soil cores during the temporary monitoring well installations. Select soil samples will also be used for the construction of microcosms in the EISB treatability study.

3.3 EISB Design and Baseline Groundwater Assessment

ERM completed a bioaugmentation treatability study, which concluded that EISB was a viable in situ remedial approach for OU2 (ERM, 2004). The conclusions of the 2004 bioaugmentation treatability study indicated: 1) the growth of indigenous microorganisms can be sustained and stimulated through the addition of an electron donor; 2) bioaugmentation is necessary to achieve complete reductive dechlorination of TCE to ethene; and 3) emulsified vegetable oil (EVO) is the best substrate given its longevity within the subsurface. Additional data collection and testing will be performed as part of the PDI to support the EISB design.

The OU2 EISB remedy will involve the subsurface delivery of a carbon source (e.g., EVO) capable of supplying electrons during oxidation-reduction (redox) reactions. Chemically reducing anaerobic conditions are required for the complete reductive dechlorination of the Site VOCs. The oxidation-reduction potential (ORP) is a measure of the tendency of the ground water to be chemically reducing (donate electrons) or oxidizing (accept electrons). Microorganisms obtain energy by transferring electrons from an electron donor to a terminal electron acceptor (TEA) such as iron, nitrate and sulfate. The TEA processes from aerobic to increasingly anaerobic are as follows:

- Oxic – significant oxygen is present (aerobic conditions).
- Nitrate reduction - nitrate is reduced under anaerobic conditions to gaseous forms or may terminate at nitrite.
- Iron reduction – ferric iron (Fe^{3+}) is reduced under anaerobic conditions to ferrous iron (Fe^{2+}).
- Manganese reduction – Manganese as Mn^{4+} is reduced under anaerobic conditions to Mn^{2+}.
- Sulfate reduction - sulfate (SO_4) is reduced under anaerobic conditions and is reduced to sulfide.
- Methanogenesis - bacteria oxidize hydrogen to create methane under strongly anaerobic conditions. Methanogenic conditions are typically required for complete biodegradation of TCE to ethene.

The EISB design requires a comprehensive groundwater biogeochemical assessment to understand redox zonation through the spatial distribution of the TEA process occurring in the aquifer. This information will support the selection and dosing of the appropriate biostimulants and bioaugmentation cultures for the full-scale EISB remedy. Purging of the temporary wells will enable the collection of field parameters to assess groundwater redox (e.g. dissolved oxygen [DO] and ORP) from temporary monitoring wells TW01 through TW10 (Figure 7). Groundwater from the temporary monitoring wells will be sampled and analyzed for anions (e.g. nitrate, nitrite, choride, and sulfate) indicative of TEA processes occurring in the overburden groundwater.

The field parameter redox and TEA data will also be part of a baseline data set representative of the OU2 overburden groundwater conditions prior to EISB treatment. Concentrations of nitrate, iron and sulfate (if present) should decrease after biostimulation until the methanogenic conditions requisite for sustaining the dehalogenating microorganisms are achieved and sustained.

Compound Specific Isotope Analysis (CSIA) will be performed on groundwater samples collected from temporary monitoring wells TW01 through TW10 (Figure 7). CSIA generates isotopic characterization of individual compounds (e.g. TCE) which can be used to quantitatively assess degradation processes (USEPA, 2008b). The collection of CSIA data before, during and after EISB treatment will provide unambiguous evidence of enhanced biodegradation, as well as the mechanisms, rate and extent of degradation of TCE in the EISB treatment area.

4. SITE MANAGEMENT PLAN (SMP)

The Site Management Plan (SMP) describes the means by which Stabilus plans to perform the RD in satisfaction of the UAO. Incorporated in this SMP are the plans for project management, project schedule, access, security, contingency procedures, management responsibilities, community relations, waste disposal, and data handling are being managed.

4.1 Project Management

The overall RD Project Management was detailed within the RDWP (see Figure 4 in RDWP). Further details specific to the completion of the PDI field activities are presented within the FSP in Section 5, and completion of the EISB treatability study within Section 6.

4.2 Remedial Design Implementation Timeline

As detailed within the RDWP, the scope of work for the RD includes completion of the ESIB design to meet the requirements within the UAO and Interim ROD. The RD requires PDI activities that include overburden groundwater delineation and completion of the EISB treatability study. Additionally, installation of performance monitoring wells within the overburden and shallow bedrock as part of the RA activities will be installed consistent with the RDWP timeline. The RD will include preparation of design drawings for a Preliminary RD, Pre-Final RD and Final RD. The implementation timeline for these tasks and the related submittals has not changed from that presented within the RDWP (see Figure 5 in RDWP).

4.3 Site Access and Control

The Site is not owned or controlled by Stabilus. In accordance with Section VIII, Paragraph 39 of the UAO, Stabilus has pursued access agreements with the current property owners. Constania has agreed to provide access to the former Stabilus facility. As of this writing, access to the former BAE facility property currently owned by Sensor has been requested but has not yet been provided. Stabilus has requested assistance from USEPA to secure access to the former BAE facility property. The access will be for the work deemed necessary to meet the obligations of the UAO for both the RD and RA to implement the interim remedy of EISB within the overburden of OU2. Stabilus will remain responsible for maintaining Site security, precluding public access for the protection of the public during completion of RD and RA field activities.

4.4 Pre-Design / Design Safety Plans

Safety plans for completion of the PDI activities include the HASP and SPCC Plan.

4.4.1 Health and Safety Plan (HASP)

A HASP was prepared to establish the procedures, personnel responsibilities and training necessary to protect the health and safety of field personnel during the completion of field

activities for the RD. The HASP was prepared per Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 requirements providing procedures and plans for routine field activities and for unexpected Site emergencies. The HASP includes delineation of exclusion zones, describes the field personnel responsible for implementing the HASP, protective personal equipment (PPE), decontamination procedures, workspace air monitoring, and medical surveillance and other requirements defined in 29 CFR 1910.120. A copy of the HASP for RD field activities is included within Appendix B.

4.4.2 Spill Prevention, Control, and Countermeasure (SPCC) Plan

The SPCC Plan focuses on spill prevention, preparedness, and response in the event of a discharge during the completion of the RD field activities. The SPCC Plan is designed to protect public health, public welfare, and the environment from potential harmful effects of a discharge to nearby water sources. The SPCC Plan was prepared per USEPA Clean Water Act regulation (40 CFR 112), and PADEP Clean Stream Law for Preparedness, Prevention and Contingency (PPC) regulation (25 PA Code 91.34).

The Site qualifies as a Tier 1 Qualified Facility, which allows the use of the Tier 1 Qualified Facility SPCC Plan Template. The Tier 1 Qualified Facility SPCC Plan Template may be used to develop a self-certified SPCC plan per USEPA 40 CFR 112.3(g)(1) of the SPCC rule. A copy of the completed Tier 1 Qualified Facility SPCC Plan was prepared for the RD field activities and is included as Appendix C.

4.5 Community Relations

Community relations are not anticipated to be necessary as part of the RD activities, and the USEPA RPM indicated during a meeting on 11 October 2012 that if deemed necessary USEPA will manage community relations as part of the RD. Stabilus will continue to support USEPA in their efforts as needed for community relations.

4.6 Permits

Permits are not anticipated to be necessary during the completion of the RD field activities.

4.7 Waste Management Plan (WMP)

During completion of the RD field activities, both solid and liquid investigation derived waste (IDW) will be produced. Waste management procedures for IDW are based on the *Management of Investigation-Derived Wastes During Site Inspections* (USEPA, 1991) and *Guide to Management of Investigation-Derived Wastes* (USEPA, 1992a), and good engineering judgment. Waste generated during RD field activities will consist of soil, groundwater, drilling mud and personal protective equipment (PPE).

4.7.1 Solid IDW

Field activities will generate IDW solids including soil cuttings and excess soil sample material. IDW of this type will be containerized in properly labeled containers for later disposal. This soil-related IDW is anticipated to be non-hazardous in nature, but will be sampled and analyzed to confirm that it is non-hazardous prior to disposal. Containerized IDW will be staged within the defined laydown and equipment staging area shown on Figure7.

IDW consisting of used PPE, disposable equipment (bailers, rope, acetate liners, etc.), and other trash that may have come in contact with contamination, will be rendered non-hazardous through the removal of gross contamination. Gross contamination removed from the PPE IDW will be placed with the appropriate IDW. IDW rendered non-hazardous through the removal of gross contamination will be bagged and disposed as municipal solid waste.

4.7.2 Liquid IDW

Field activities will generate liquid IDW including purge fluid and excess sample material. Liquid IDW of this type will be containerized in properly labeled containers for later disposal. This groundwater-related liquid IDW is anticipated to be non-hazardous in nature, but will be confirmed prior to disposal. Containerized liquid IDW will be staged within the defined laydown and equipment staging area shown on Figure 7.

4.8 Data Management

Data will be managed using the EnviroData data management system in conjunction with the ArcView geographic information system (GIS) tools to manage, summarize, and present the data.

5. FIELD SAMPLING PLAN (FSP)

This section presents the organizational structure for sampling and analysis activities associated with the PDI, including team organization and responsibilities, fieldwork schedule, sampling methods, data management, and laboratory analyses. The focus of the PDI field sampling effort is to complete the overburden groundwater delineation and to collect soil and groundwater for the EISB treatability study. The FSP is presented below. The EISB treatability study plan is presented in Section 6. Copies of Geosyntec standard operation procedures (SOPs) referenced below are provided in Appendix D.

5.1 Team Organization and Responsibilities

The organizational structure for the PDI team is presented in Figure 8 and summarized as follows:

- **USEPA:** The USEPA is the lead governmental agency for the Site. The USEPA will oversee all aspects of the interim remedy RD/RA. Ms. Sharon Fang is the Remedial Project Manager (RPM) for USEPA, responsible for overall oversight of the NP5 Site and OU2 interim remedy and monitoring compliance of the interim remedy with the Interim ROD and UAO;
- **USEPA RD Oversight Contractor:** The USEPA RD Oversight Contractor assists the USEPA RPM on oversight of the RD, RD Site activities, and other technical aspects of the completion of the RD for the interim remedy. Hydrogeologic, Inc. in Philadelphia, Pennsylvania will serve as the USEPA RD Oversight Contractor;
- **Pennsylvania Department of Environmental Protection:** PADEP is the support agency to USEPA for the Site. PADEP will review and provide their input or concurrence, as needed during completion of the RD/RA components of the interim remedy. Mr. Timothy Cherry of PADEP is the current point of contact;
- **Supervising Contractor and Project Coordinator:** Geosyntec is the Supervising Contractor and Mr. Derek W. Tomlinson, P.E., of Geosyntec is the Project Coordinator. The Project Coordinator will act as a liaison between the USEPA, Stabilus, RD contractors and subcontractors, and RA contractors and subcontractors. The Project Coordinator will verify that the PDI, RD, and RA activities are performed in substantial accordance with the UAO and Interim ROD and other related technical design requirements;
- **Remedial Design Contractor:** Geosyntec is the RD Contractor. The RD Contractor will fulfill the requirements of the UAO specific to the RD of the USEPA selected remedy. The RD Contractor personnel consists of the following:
  - RD Engineer is Mr. Derek W. Tomlinson, P.E.;
  - RD Geologist is Mr. Christopher Voci, P.G.;
  - Quality Assurance Officer is Ms. Julia K. Caprio, M.Sc., MBA;

  - Project Environmental, Health and Safety Officer is Mr. Scott Douglas with support from Corporate EHS Officer Mr. Dale Prokopchak, CIH, CSP;
  - Field Manager and Site Health and Safety Officer is Ms. Michelle Mirigliano; and
  - Field Scientists are yet to be determined.
- **EISB Treatability Study Subcontractor:** SiREM Laboratories, Inc. (SiREM) of Guelph, Ontario, Canada will perform the EISB treatability study and related analytical services. The SiREM point of contact will be Ms. Sandra Dworatzek;
- **Laboratory Subcontractors:** Laboratory analytical services will be provided by the following:
  - Lancaster Laboratories, Inc. (Lancaster) of Lancaster, Pennsylvania will perform laboratory analytical analysis services for overburden groundwater delineation, baseline conditions including soils and natural attenuation parameters analysis, and groundwater analysis if needed during the performance monitoring well network installation activities. Lancaster is a National Accredited Laboratory Accreditation Program (NELAP) and PADEP certified laboratory (Certification No. 36-00037). Lancaster point of contact will be Ms. Barbara Weyandt; and
  - SiREM Laboratories, Inc. / University of Toronto Stable Isotopes Laboratory (UT-SIL) of Toronto, Ontario, Canada is a contract laboratory of SiREM. UT-SIL will perform CSIA analysis UT-SIL points of contact will be Ms. Sandra Dworatzek of SiREM and Dr. Barbara Sherwood-Lollar of UT-SIL.
- **Drilling Subcontractor:** Advanced Drilling, Inc. (Advanced) of Pittstown, New Jersey will perform drilling related services. Advanced is a licensed driller within the Commonwealth of Pennsylvania (Registration No. 2178). Advanced point of contact will be Ms. Vicky Alberalla and Mr. Brian Wagner;
- **Land Surveyor:** Dennis W. Sklar, Inc. (DWS) of Philadelphia, PA will complete surveying services. DWS is a licensed Land Surveyor within the Commonwealth of Pennsylvania (License No. SU075154). The land surveyor will be required during the RD field activities to survey in the investigation locations during the overburden groundwater delineation, existing monitoring wells within OU2, and the newly installed performance monitoring wells; and
- **Utility Clearance Subcontractor:** The utility clearance subcontractor is yet to be determined, but will be used for subsurface utility clearance prior to completion of intrusive field investigation activities as part of the OU2 overburden groundwater delineation and performance monitoring well network installation RD field activities.

5.2 Field Sampling Schedule

The RD Implementation Timeline was presented within the RDWP (see Figure 5 of RDWP). Per the RDWP, the PDI field activities will begin immediately upon approval of this PDI Work

Plan. Per the RDWP, the PDI activities (i.e., groundwater delineation and EISB treatability study) will be completed in approximately 165 days. The overburden groundwater delineation field activities will be completed in approximately 65 days assuming no delays or requirements for additional delineation sampling.

As noted in the RDWP, overburden groundwater delineation field activities may require additional time. If initial laboratory analytical results indicate further delineation is required, an extension of the submittal of the Intermediate (60%) Design Submittal will be requested to USEPA to allow for the inclusion of the additional overburden groundwater delineation sampling results. If extension of submittal of the Intermediate (60%) Design submittal is not granted by USEPA, then partial overburden groundwater delineation results will be provided in the Intermediate (60%) Design submittal with the remaining results submitted within the Pre-Final (90%) Design submittal.

As outlined within the RDWP, the overburden groundwater delineation field activities and preliminary/interim results of the EISB treatability study will be presented within Preliminary PDI Report within the Intermediate (60%) Design submittal and the final EISB treatability study results will be presented within the Final PDI Report within the Pre-Final (90%) Design submittal.

5.3 Field Activities

After procurement of materials, subcontracting and securing of access agreements for the facilities within the overburden area of OU2, the planned PDI field activities include the following:

- Site reconnaissance and investigation siting;
- Subsurface utility clearance;
- Clearing/grubbing (if necessary);
- Overburden groundwater delineation field activities which includes:
  - Temporary monitoring well soil profiling and soil sampling,
  - Temporary monitoring well installation, groundwater monitoring and sampling,
  - Direct push groundwater sampling, and
  - Direct push and temporary monitoring well abandonment.
- EISB treatability study soil and groundwater collection;
- Assessment and disposal of PDI IDW; and
- Survey of overburden groundwater sampling locations and existing OU2 monitoring well network.

5.4 Field Operations and Sampling Procedures

Each sample, field measurement, and field activity will be properly documented to facilitate timely, correct, and complete analysis of actions concerning the PDI.

5.4.1 Field Preparation

As preparation for PDI field activities, the following preparations will be undertaken:

- The RD Project Manager or Field Manager will ensure that subcontractors (i.e., drilling, surveying, laboratories, etc.) have been contracted and scheduled;
- The RD Project Manager or Field Manager will ensure all necessary supplies (i.e., sampling tools, instruments, sample containers, etc.) have been ordered and are ready for use;
- Stabilus has obtained access form Constantia to the former Stabilus facility property and it has made several requests to Sensor for access to the former BAE property for the PDI sampling locations. Additional assistance has been requested from USEPA to secure access to the former BAE property and Stabilus will continue working with USEPA to secure such access as needed for the PDI field activities; and
- Coordination regarding sample collection, delivery, analysis, and requested deliverables will be undertaken with the various laboratory contacts.

5.4.2 Field Documentation Procedures

Field sampling operations and procedures, observations, and other pertinent information will be documented by field personnel in bound field logbooks and the appropriate field forms. When appropriate, field operations and procedures will be photographed. Documentation of sampling operations and procedures will include but not limited to documenting the following:

- Time and date on and off the Site of field personnel;
- Start/stop time of Site activities;
- Weather conditions;
- Daily objective;
- Calibration of field instruments;
- Field sampling equipment used including serial numbers;
- Lithological descriptions;
- Static water level measurements;
- Pumping rates and water quality parameters; and
- Sample location identification and list of analyses.

Field logbooks will be waterproof and bound. The logbooks will be dedicated to the Site. No pages will be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or at the end of each day of activities.

5.4.3 Site Reconnaissance and Investigation Siting

Site reconnaissance will be completed in order to locate the proposed overburden groundwater sampling locations shown on Figure 7. A handheld Global Positioning System (GPS) unit will be used to mark proposed locations in the field.

As part of this Site reconnaissance, the GPS unit will be used to aid in locating the existing monitoring well network for OU2. The monitoring wells will be assessed to determine if clearing and grubbing will be required to access them. Each monitoring well will be inspected for integrity and will be sounded with an electronic water level meter to measure the depth to groundwater and total monitoring well depth.

5.4.4 Subsurface Utility Clearance

The drilling or excavation contractor will be responsible for contracting Pennsylvania "One-Call" System prior to performing any subsurface drilling or excavation work by calling "811". The utility company mark-outs provided by the "One-Call" service are required to address underground public utility lines (e.g., gas, water electric, communications, etc.) regardless of whether or not they are on private property. The notification to "One-Call" must be made by the drilling or excavation contractor. The notification may not be made by other parties (e.g., consultant, property owners, government agency, etc.).

Supplemental utility clearance will be performed in the vicinity of each drilling location in addition to the "One-Call" notifications. The supplemental clearance is required given the "One-Call" system does not enter onto private property, nor does it locate on Site (non-public) utilities. A subsurface utility locating subcontractor will screen each sampling location using various geophysical techniques (i.e., ground penetrating radar, GPR; electromagnetic survey, EM; etc.). Locations will also be clear of any over-head power lines or other obstructions.

5.4.5 Overburden Groundwater Delineation Field Activities

Figure 7 presents the proposed overburden groundwater delineation sampling locations. The rationale for the sampling locations and analysis were summarized in Section 3. A total of 38 sampling locations will be completed. As noted in Section 3, ten sampling locations along the low in the bedrock topography will be completed as temporary monitoring wells and will include both soil and groundwater sampling for VOC laboratory analysis shown as TW01/SB01 to TW10/SB10 on Figure 7. Groundwater samples from the temporary monitoring well locations will also be analyzed for CSIA, and monitored natural attenuation parameters to provide baseline

data for the EISB remedy. The remaining 28 sampling locations will be collected as direct push groundwater samples using a HydroPunch™ or similar probe as shown as TW11 to TW38 on Figure 7.

5.4.6 Temporary Monitoring Well Soil Profiling and Sampling

For the 10 temporary monitoring well installations the direct push technology will be used (Geoprobe® or similar rig) to conduct the subsurface investigation (i.e. soil boring and temporary monitoring well installation). Sampling will be in accordance with Geosyntec's *Standard Operating Procedure No. 240 – Direct Push Soil Sampling*. Continuous soil cores will be collected at 4-foot intervals in acetate liners until refusal at the top of bedrock. Field personnel shall note the soil type, color, odor, amount of recovery, screen the soil core for VOCs by using a PID, and the depth of refusal. Soil descriptions will be documented according to Geosyntec's *Standard Operating Procedure No. 210 – Soil Description Visual-Manual Procedure of the Unified Classification System.* Information shall be documented in the field logbook and on lithologic boring logs.

Soil samples will be collected from TW01/SB01 to TW10/SB10 shown on Figure 7 from the six-inch interval above the weathered bedrock zone, or from the six-inch interval with elevated PID readings or where visual staining is observed. VOC sample collection will be directly from the acetate liner, within an undisturbed interval of the core, using a 5-gram Terra-core sampler.

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix E, with a summary of the QA/QC samples to be collected provided within Section 5.4.7.

5.4.7 Temporary Monitoring Well Installation, Groundwater Monitoring, and Sampling

Upon reaching the target depth at locations TW01 through TW10, a temporary 1-inch PVC screen and riser shall be installed into the boring to allow for the collection of groundwater samples. The temporary monitoring well will be installed and the well will be sampled within 48-hours. A complete synoptic round of groundwater elevations measurements will be collected following completion of all temporary monitoring well installations and prior to their abandonment. Groundwater samples from the temporary groundwater monitoring wells will be collected in accordance with the USEPA *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (USEPA, 2002e) and the USEPA-Region II *Low Stress Groundwater Sampling Protocol* (USEPA, 1998). Groundwater sampling will require the use of the following equipment:

- Peristaltic, bladder, or submersible pump capable of a flow rate between 100 and 500 millimeter per minute (mL/min). Pump type will depend on depth to water and well diameter;
- Power source and/or compressor;
- Water quality meter with flow through cell (i.e. YSI or similar) for measuring pH, temperature, specific conductance, DO, turbidity, and ORP;
- Calibration solutions for the water quality meter;
- Hach color metric test kit for ferrous iron;
- Electronic water level meter;
- Graduated cylinder and stopwatch to measure flow rate;
- Field logbook;
- PPE;
- 5-gallon bucket and/or 55 gallon drum to containerize purge water; and
- Decontamination supplies.

Prior to well purging, the water quality parameter meter will be calibrated in accordance with the manufacturer's specifications. Calibration information will be recorded in the field logbook and/or field forms as appropriate. The pump will then be carefully lowered to the approximate middle of the temporary monitoring well screened section, tubing will be connected to the flow through cell, and a discharge line will run from the flow through cell to the bucket or drum. Pumping will begin at a steady rate between 100 to 200 mL/min, and depth to water measurements will be collected frequently to ensure less than 0.1 feet of drawdown occurs. Water quality parameter readings and depth to groundwater measurements will be collected every 5 minutes while purging. Purging will continue until water quality parameters stabilize (three consecutive readings), which is defined as follows:

- ±0.1 units for pH;
- ±3% for specific conductance;
- ±10 mV for ORP;
- ±10% for temperature;
- ±10% for turbidity for values greater than 10 NTUs; and
- ±10% for DO.

Samples will be collected after water quality parameters have stabilized and measurements recorded. Given that the sampling will be completed from temporary monitoring wells, turbidity may not stabilize as quickly as the other parameters. If all other parameters have stabilized, then turbidity may be disregarded.

The pump rate and sample intake location will not be adjusted between purging and sampling. Samples will be obtained from the influent line prior to the flow through cell.

Sample containers will be filled in the following order: VOCs, CSIA, dissolved hydrocarbon gases (DHG; e.g., ethene, ethane or methane), general chemistry parameters (e.g., alkalinity and anions), and field measure of ferrous iron (via Hach test kit).

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, detection limits, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix E, with a summary of the QA/QC samples provided within Section 7.

5.4.8 Direct Push Groundwater Sampling

Direct push technology will be used (Geoprobe® or similar rig) to complete the HydroPunch™ or similar groundwater sampling. HydroPunch™ or similar groundwater sampling tools will be used to collect grab groundwater samples. Direct push drill rods will be advanced until refusal. Upon reaching refusal, a discrete groundwater sample will be collected via either bailer or peristaltic pump. Sampling information shall be documented in the field logbook.

Direct-push groundwater sampling via HydroPunch™ will be completed at sampling locations TW11 to TW38 shown on Figure 7. The grab groundwater sample will be collected from the interval just above refusal which is assumed to be just above the top of bedrock at the interface of the overburden and bedrock aquifers.

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix E, with a summary of the QA/QC samples to be collected provided within Section 5.4.7.

5.4.9 Direct Push and Temporary Monitoring Well Abandonment

Upon completion of the overburden soil and groundwater investigation and survey, all temporary monitoring well points will be abandoned according to Geosyntec's *Standard Operating Procedure No. 140 – Well Abandonment*. An approximately 6-inch length of reinforcement bar will be placed within the abandoned OU2 overburden groundwater sampling location just beneath ground surface to aid in field locating at a future date. The direct push sampling locations will be abandoned immediately following collection of groundwater samples.

The temporary groundwater monitoring wells will be abandoned after a synoptic round of groundwater level measurements has been collected from TW01 through TW10. Direct push and temporary groundwater monitoring well locations will be surveyed by a PA-licensed land surveyor as noted in Section 5.4.10.

5.4.10 Collection of Groundwater & Soils for EISB Treatability Study

As part of the PDI field activities, soil and groundwater will be collected for EISB treatability study microcosm construction. Approximately 2 kilograms of soil and 6 liters of groundwater will be collected in the general area of TW01/SB01 as shown on Figure 7. Soil and groundwater samples will be shipped to SiREM following standard international shipping procedures.

5.4.11 Soil and Groundwater Sampling Quality Assurance and Quality Control

Per Section 7, the appropriate quality assurance/quality control (QA/QC) samples will be collected for each media sampled. A summary of the field QA/QC samples to be collected during the PDI will include the following:

- Trip blanks for VOCs (one per sample cooler containing VOC samples);
- Duplicate samples (sample frequency of 1 per 20 samples for VOCs);
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) (sample frequency of 1 per 20 samples for VOCs; and
- Field equipment rinsate blank (sample frequency of one per day of sampling for VOCs).

QA/QC samples are further described in Section 7 and the QAPP in Appendix E.

5.4.12 Sample Handling and Transport

Sample handling and transport will be completed in accordance with Geosyntec's *Standard Operating Procedure No. 410 – Packaging and Shipping of Environmental Samples*. Sample jars, coolers, and packaging material will be supplied by the analytical laboratory. Details on the numbers and type of sample containers are provided in the QAPP. Equipment needed for packaging and shipping sample coolers will include the following:

- Sturdy sample cooler;
- Plastic zip-top bags of various sizes;
- Clear plastic packing tape;
- Ice;
- Custody seals;
- Completed chain-of-custody record; and,
- Completed air bill.

Proper packaging is necessary to ensure the protection of the samples during shipment. The following steps should be followed when packing sample coolers for shipment via air:

- Caps on bottleware are secure; check labels/tags, and chain-of-custody are filled out properly;
- Double bag ice in large plastic zip-top bags and seal;
- All sample containers will be placed in an appropriately-sized plastic zip-top bag. Glass bottles shall be wrapped in bubble wrap before placing in zip-top bag;
- The chain-of-custody record will be placed in a plastic zip-top bag and taped to the inner side of the sample cooler lid;
- Clear packing tape will be wrapped around the ends of the sample cooler twice before attaching the signed custody seals to the top half of the sample cooler. Clear packing tape shall be wrapped over the custody seals; and
- Address labels and/or air bills will be affixed to the outside of the cooler.

5.4.13 Equipment Decontamination

Non-disposable/non-dedicated sampling equipment (pumps, stainless steel bowls, trowels, etc.) will be decontaminated after sampling at each location is completed. Equipment decontamination will be performed in accordance with Geosyntec's *Standard Operating Procedure No.004 Equipment Decontamination* document. Equipment decontamination will consist of the following procedures:

- Disassemble pump (if necessary);
- Potable water rinse;
- Alconox solution wash;
- Deionized water rinse;
- Methanol spray (pesticide-grade) rinse;
- Air dry;
- Final deionized water rinse; and
- Air dry.

Once the equipment is dry, it will be re-assembled for reuse at the next location or wrapped in aluminum foil or use during the next day's activities.

5.4.14 Survey of Overburden Groundwater Sampling Locations and Existing OU2 Overburden and Bedrock Wells

Upon completion of intrusive activities and prior to abandoning the temporary monitoring wells, survey of OU2 intrusive investigation locations and existing OU2 monitoring wells will be completed by DWS, a Pennsylvania-licensed Land Surveyor. The survey will include horizontal and vertical control referenced to the Pennsylvania State Plane Coordinate System NAD 1983 and NAVD 1988, of all new soil borings/temporary monitoring wells and direct push

groundwater sampling locations completed during PDI field activities as well as existing overburden and bedrock monitoring wells related to OU2. For existing overburden and bedrock monitoring wells, the reference notch in the top of the riser pipe, the monitoring well monument, and the concrete base (or ground surface if no concrete base is present) will be surveyed to the nearest 0.01 foot relative to mean sea level. For the PDI locations the ground surface at the location of the collected samples and the top of the temporary monitoring well casing will be surveyed.

5.4.15 Management of Investigation Derived Waste

Waste generated during Site investigation will be managed per the WMP presented in Section 4. Waste streams generated, as part of the PDI field activities will consist of soil, groundwater, and PPE. Soil waste will be generated from soil borings and monitoring/temporary monitoring well installation. Waste-water will be generated from well installation, well development, sampling, and decontamination. PPE and other disposable equipment, which may be used during investigation activities, include: acetate liners, tubing, plastic sheeting, nitrile gloves, etc.

All wastes generated will be segregated and containerized in 55-gallon steel drums, staged in the equipment staging and waste management area, and labeled as non-hazardous waste as defined in the WMP. Upon completion of investigation activities, wastes will be profiled and scheduled for transport and taken to an appropriate off-site disposal facility.

5.5 Sample Designation

A sample numbering system will be used to identify each sample collected for laboratory analysis during the PDI. The numbering system will ensure that each sample is uniquely identified and will allow for retrieval of sample information about a particular sample location from a database. The field personnel will maintain a listing of sample numbers in the form of a sample log.

The field personnel will record the sampling activities for each day in the field logbook. The following information will be recorded for each sample:

- Unique sample location identification number:
  - TW01_mmddyy for groundwater sampling locations, and
  - SB01(depth-depth)_mmddyy for soil sampling locations;
- Date/time of sample collection;
- Sampler's initials;
- Volume of sample needed for specific analysis; and
- Analysis required and preservative.

6. EISB TREATABILTY STUDY

The objective of the EISB treatability study is to develop EISB design criteria to be used in the RD. The preliminary/interim results of the EISB treatability study will be presented in the Preliminary PDI Report as part of the Intermediate (60%) Design Submittal, with the complete EISB treatability study results presented in the Final PDI Report as part of the Pre-Final (90%) Design Submittal.

6.1 Microcosm Construction

Anaerobic microcosms will be constructed by filling 250 mL (nominal volume) glass bottles with approximately 200 mL of Site groundwater and 60 grams (g) of soil, leaving a nominal headspace for gas production (e.g., carbon dioxide [CO_2] and/or methane). In order to maintain anaerobic conditions, the anaerobic microcosms will be constructed in a disposable anaerobic glove-bag, and will be stored and sampled in an anaerobic chamber.

The groundwater for the sterile control microcosms will be amended with mercuric chloride and sodium azide and the soil will be autoclaved to inhibit microbial activity. Anaerobic intrinsic control microcosms will be used to measure intrinsic biodegradation activity and will not receive electron donor amendments. A slow release EVO with the addition of a sodium bicarbonate buffer will be used as the electron donor, with and without bioaugmentation. The electron donor concentration will be based on either the stoichiometric electron donor demand, or upon laboratory dosages used successfully by SiREM in previous biotreatability studies, or the vendor's recommendations. Sodium bicarbonate will be added at a concentration suitable to maintain the pH around 6.8 to 7.2. One replicate of each anaerobic control and treatment will be amended with resazurin to monitor redox conditions.

Based upon evaluation of the ongoing results, the designated electron donor treatment microcosms will be amended with a dehalorespiring microbial consortium (KB-1® Plus) to assess the ability of these bacteria to promote or accelerate complete reductive dechlorination.

All treatments will be constructed in triplicate as detailed in Table 2. Microcosms will be sealed with Mininert™ valves to allow repetitive sampling of each microcosm, and to allow addition of amendments to sustain metabolic/biodegradation activities.

6.2 Microcosm Incubation, Sampling and Analysis

Biotreatability microcosms will be incubated for a period of approximately six months. Aqueous samples will be collected from the control and treatment microcosms every two to three weeks for analysis of VOCs including PCE, TCE, cDCE, VC and DHGs. In addition, at three selected time points, the electron donor amended microcosms will be sampled for analysis of volatile fatty acids (e.g., lactate, acetate and propionate) to permit evaluation of electron donor

fermentation and longevity. Other analyses will include the measurement of pH and anions (i.e., sulfate, nitrate, chloride and phosphate) by SiREM.

Baseline Dehalococcoides (Dhc), Dehalobacter (Dhb) and vinyl chloride reductase (vcrA) quantification (Gene-Trac® Dhb and Gene-Trac® VC) will be performed on the groundwater collected from the site to quantify and assess the dechlorination potential of indigenous bacteria. Dhc and vcrA analysis will also be performed at the mid-point (pre-bioaugmentation) and end of the EISB treatability study (post bioaugmentation) on the biostimulated and bioaugmented treatment microcosms. Samples from the individual replicates from the biostimulated and bioaugmented treatment microcosms will be combined to provide sufficient volume (30 mL) for this analysis.

Table 3 provides a summary of the sampling parameters and frequency to be completed during the EISB treatability study. Sampling intervals for individual treatments may be modified (either shorter or longer intervals) during the EISB treatability study based on observed microbial activity, VOC degradation rates, and depletion of electron donors/acceptors.

7. QUALITY ASSURANCE AND QUALITY CONTROL

A summary of the QA/QC procedures, routines, and specifications for activities to be completed during the RD field activities is summarized herein. Details of the QA/QC program are provided in the attached QAPP included as Appendix E. The QAPP was prepared following USEPA *Guidance for Quality Assurance Project Plans* (USEPA, 2002f), and USEPA *Requirements for Quality Assurance Project Plans* (USEPA, 2001). The QAPP addresses sampling procedures, personnel qualifications and data reduction, validation, and reporting. The QA/QC procedures and SOPs for laboratories used during the RD are included in the QAPP including their qualifications within Appendix E.

7.1 Sample Containers and Preservation

The analytical laboratory will supply all bottleware including appropriately preserved sample containers in sealed coolers. The field personnel will be responsible for properly labeling the containers in the field.

7.2 Field Quality Control Samples

Field duplicate samples, field equipment rinsate blanks, and MS/MSD samples will also be collected. Trip blanks will be provided by the analytical laboratory. The field duplicate samples will be labeled with fictitious identification locations and times, and submitted to the laboratory as regular samples. The actual identification of the field duplicate samples will be recorded in the field logbook. A summary of the field QA/QC samples to be collected during sampling are as follows:

- Field duplicate samples will be analyzed for VOC parameters;
- Trip blank samples will be analyzed for VOC parameters and accompany the sample cooler;
- MS/MSD samples will be collected and analyzed for VOC parameters as a check on laboratory quality assurance; and
- Field equipment rinsate blanks will be analyzed for VOC parameters.

7.2.1 Field Duplicate Samples

Field duplicate samples are independent samples collected in such a manner that they are equally representative of the sampling point and parameters of interest at a given point in space and time. Field duplicate samples provide precision information of homogeneity, sample collection, handling, shipping, and storage of samples.

Field duplicates will be collected immediately after the original sample is collected. Field duplicate samples will be analyzed with the original field samples for VOC parameters. One of every twenty (20) samples will be duplicated.

7.2.2 Trip Blanks

Trip blanks are required for VOC samples. They consist of a set of sample bottles filled at the laboratory with laboratory demonstrated analyte free water. Trip blanks accompany sample bottles into the field and are returned to the laboratory along with the collected samples for analysis. Trip blanks must return to the laboratory with the same set of bottles they accompanied to the field.

7.2.3 Field Equipment Rinsate Blanks

The field equipment rinsate blank is designed to address cross-contamination between sample points in the field due to deficient equipment decontamination procedures and through contamination of ambient sources.

One field equipment rinsate blank will be collected and analyzed for VOC parameters each field sampling day.

7.2.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD samples are a form of laboratory QA/QC for determining matrix effects for the laboratory analysis. The matrix effect is a condition in which sample composition interferes with the analysis of the desired analytes. Spiked sample recovery supplies percentage recovery information so that the laboratory can evaluate its measurement accuracy. MS/MSD samples are equal portions of a single initial sample that has been spiked in the laboratory with specific analytes in known quantities and the analytical results must meet certain laboratory requirements to be acceptable.

One MS/MSD sample will be collected and analyzed for VOC parameters for every twenty (20) samples collected as applicable to the method.

7.3 Chain of Custody Procedures

Sample identification and chain-of-custody shall be maintained for the Site through the chain-of-custody procedures as described in the QAPP:

- Sample labels, which prevent misidentification of samples;
- Custody seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory;

- Field logbooks and forms to record information about the Site investigation and sample collection; and
- Chain-of-custody records to establish the documentation necessary to trace sample possession from the time of collection to laboratory analysis.

8. REFERENCES

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TABLES

TABLE 1: Sampling and Analysis Summary
Operable Unit 2 North Penn Area 5 Superfund Site

Matrix	Sample Location	Analytial Parameter	Analytical Method	Containers (Numbers, Size, and Type)	Preservation Reqiurements	Number of Sampling Locations	Number of Field Duplicates	Number of MS/MSDs	Number of Blanks (Trip / Field Equipment Rinsate)	Total Number of Samples to Laboratory	Holding Times
Soil	SB-01 to SB-10	VOCs	5035/8260B	3 - 5 gram Terracore	Methanol/ Sodium Bisulfate/ water Cool 4+/-2°C	10	1 per 20 samples	1 per 20 samples	1 per cooler / 1 per day	15	48 hrs
Groundwater	TW-01 to TW-38	VOCs	5030C/8260B	3 - 40 mL glass vials	HCl pH<2 Cool 4+/-2°C	38	1 per 20 samples	1 per 20 samples	1 per cooler / 1 per day	54	14 days
Groundwater	TW-01 to TW-10	Alkalinity	SM20 4500 H/B	1 - 250 mL plastic	Cool 4+/-2°C	10	N/A	N/A	N/A	10	28 days
Groundwater	TW-01 to TW-10	Anions	300.0	1 - 250 mL	Cool 4+/-2°C	10	N/A	NA	N/A	10	28 days (nitrate/ nitrate 48 hrs)
Groundwater	TW-01 to TW-10	DHG	RSK175	3 x 40 mL glass vials	HCl pH<2 Cool 4+/-2°C	10	N/A	NA	N/A	10	14 days
Groundwater	TW-01 to TW-10	CSIA	Lab Specified SOP	6 x 40 mL glass vials	HCl	10	N/A	N/A	N/A	10	3 months

Notes:
VOCs = volatile organic compounds
DHG = dissolved hydrocarbon gases
CSIA = compound specific isotopes analysis
HCl = hydrochloric acid

TABLE 2: Summary of EISB Treatability Study Microcosm Setups
Operable Unit 2 North Penn Area 5 Superfund Site

	Treatment/Control	**Description**	**Replicates**
1	Sterile Control	Autoclaved and amended with mercuric chloride and sodium azide	3
2	Anaerobic Intrinsic Control	Unamended	3
3	Electron Donor Amended	Amended with EVO as electron donor	3
4	Buffered Electron Donor Amended	Amended with EVO as electron donor + pH buffer	3
5	Buffered Electron Donor Amended +Bioaugmentation	Amended with EVO as electron donor + pH buffer + KB-1® bioaugmentation	3
Total Microcosms			15

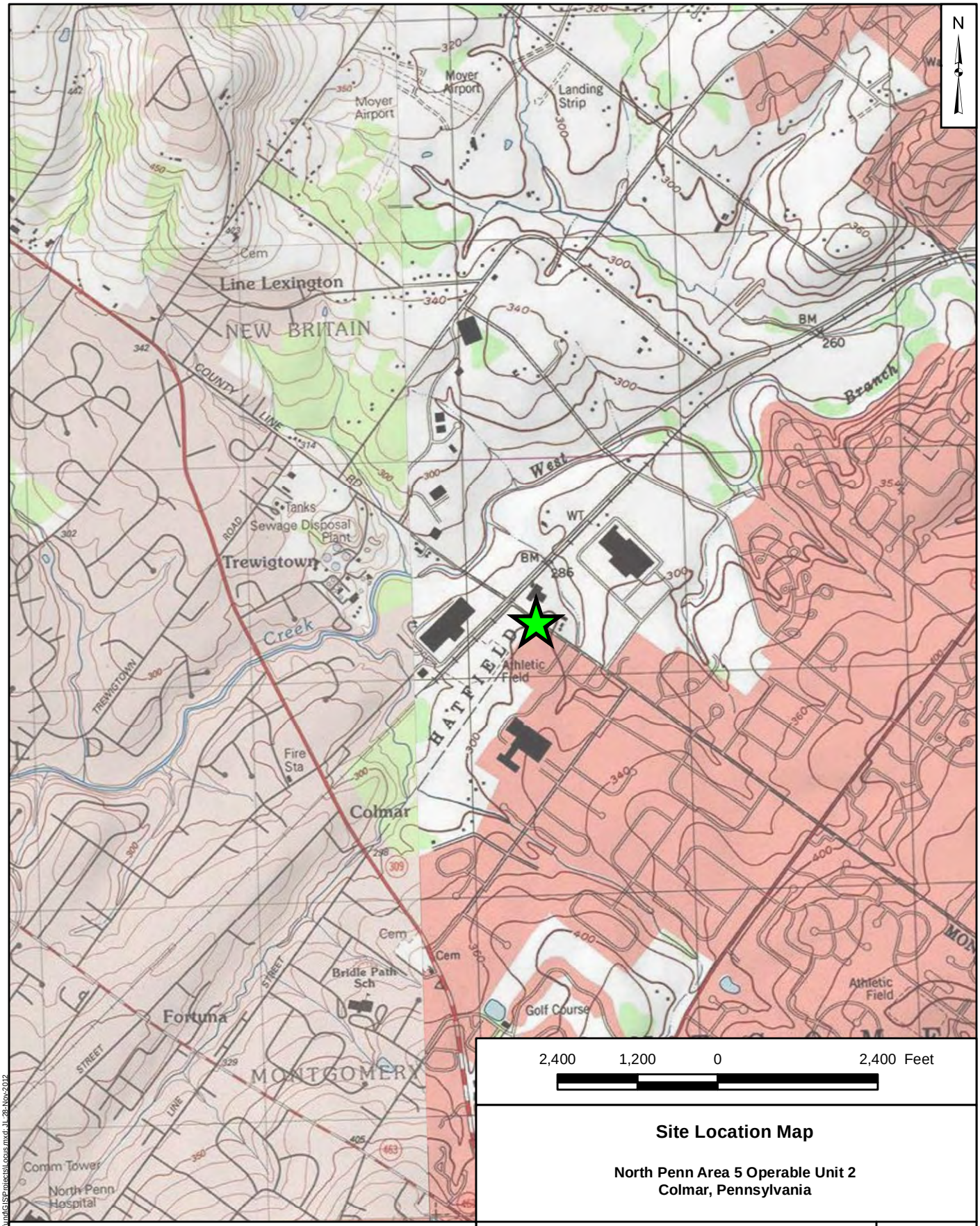
Notes:
EVO - emulsified vegetable oil

TABLE 3: EISB Treatability Study Scope of Sampling and Analyses
Operable Unit 2 North Penn Area 5 Superfund Site

Analyte	Number of Microcosms	Number of sample events	Total number of analyses
VOCs + DHGs	15	7 + 3 baseline	108
Anions	15	4 + 3 baseline	63
VFAs	9	3	27
pH	15	As required	TBD
Dhc, Dhb and vcrA	9	2 + 1 baseline	7

Notes
VOCs - volatile organic compounds
DHGs - dissolved hydrocarbon gases
VFAs - volatile fatty acids
Dhc - dehalococcoides
Dhb - Dehalobacter

FIGURES



Site Location Map

North Penn Area 5 Operable Unit 2
Colmar, Pennsylvania

Notes

Base Map: USGS Doylestown(1999) and Telford (1997)
7.5 Minute Quadrangles.

Geosyntec consultants

Blue Bell, PA | 29 November 2012

Figure **1**

P:\RR\1PH0013-NP5.OU2.Superfund\GIS\Projects\Locus.mxd; 1; 28-Nov-2012

North Penn Area 5 Site Location Map

Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania

Geosyntec consultants

Blue Bell, PA | 18 March 2013

Figure **2**

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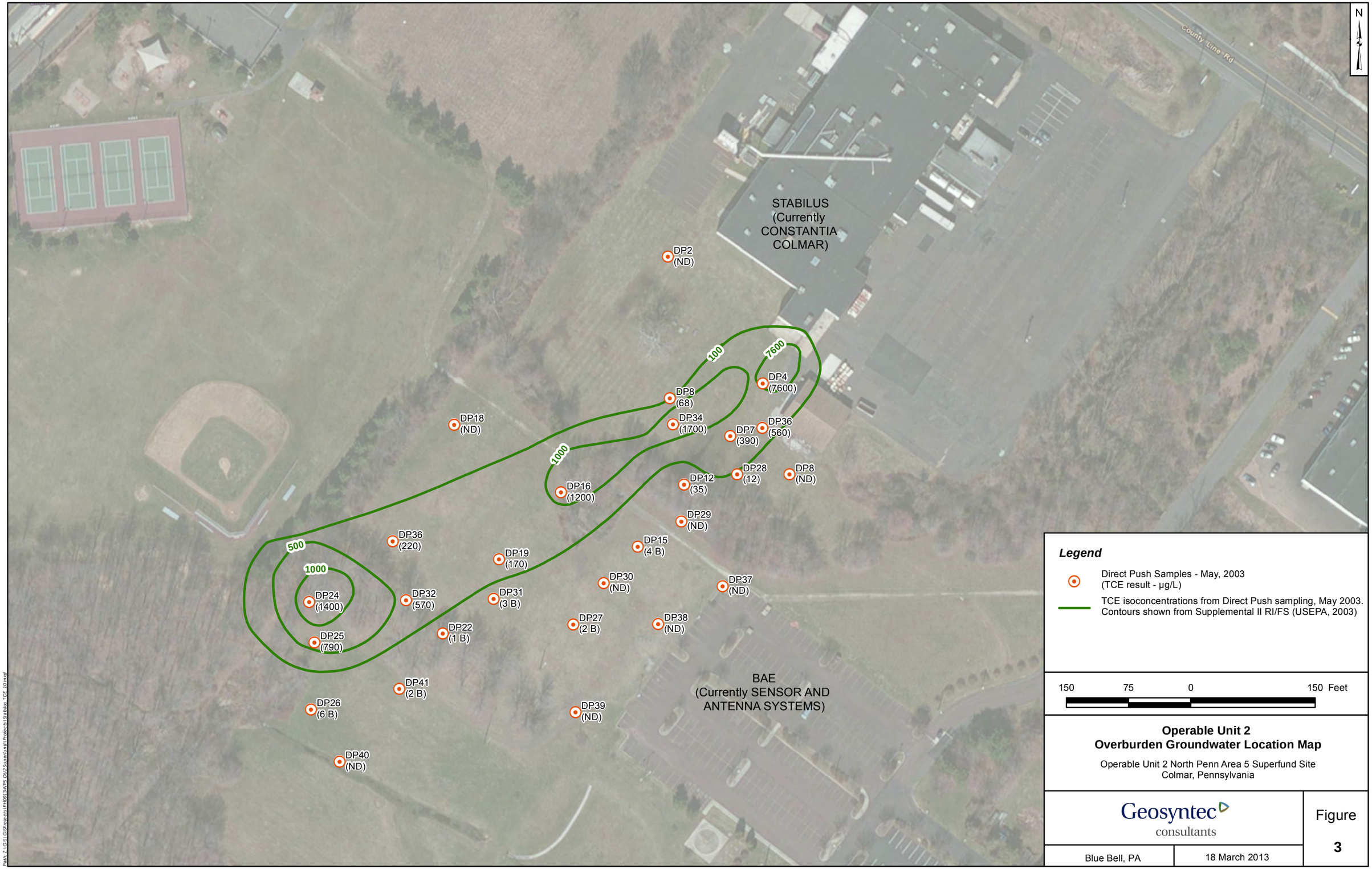


Operable Unit 2
Overburden Groundwater Location Map

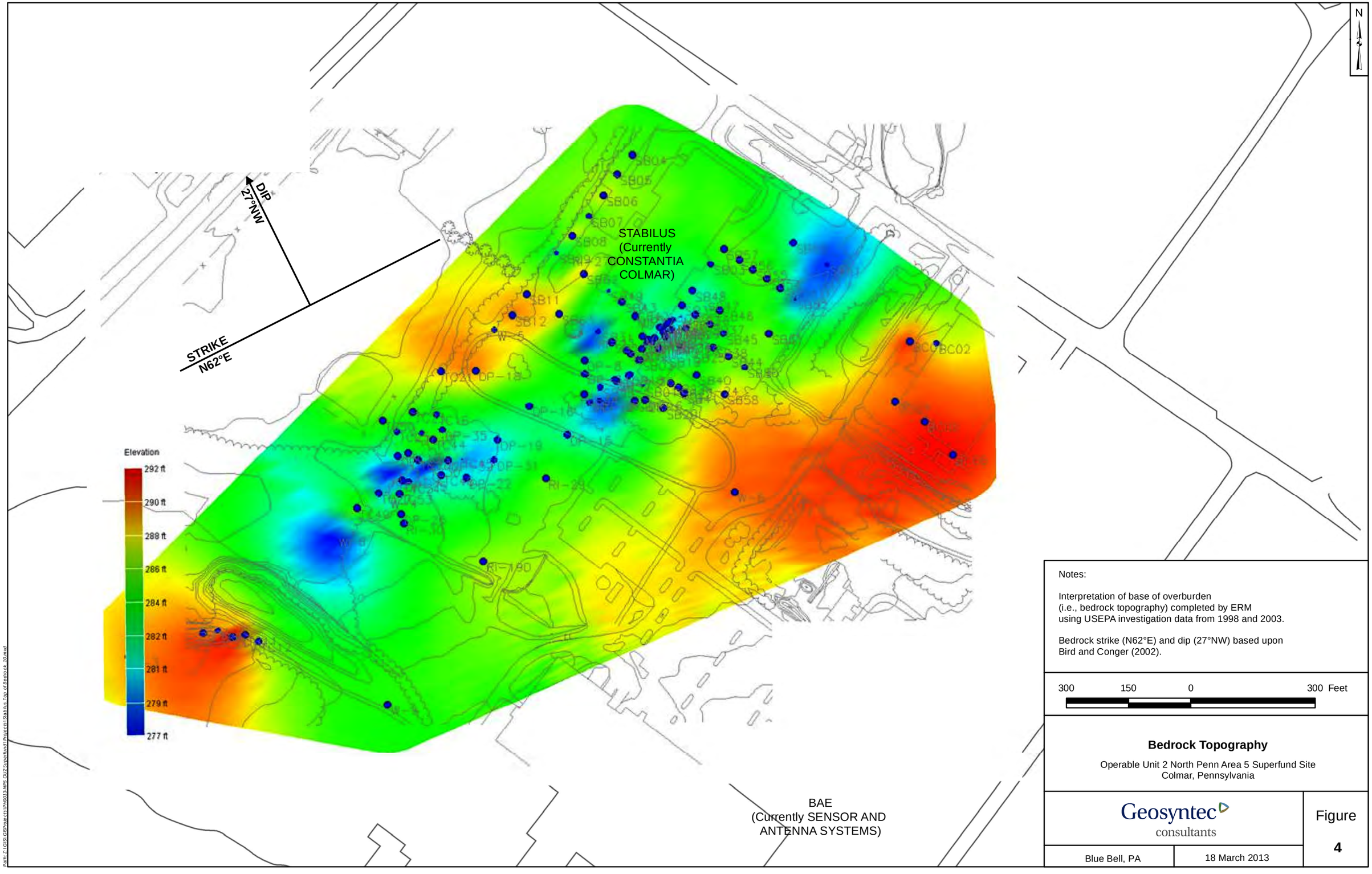
Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania

Geosyntec consultants

Figure **3**

Blue Bell, PA | 18 March 2013

Path: Z:\GIS\GSP\projects\PH9013-MP5 OU2 Superfund\Projects\Stabilus_TCE_10.mxd



Notes:

Interpretation of base of overburden
(i.e., bedrock topography) completed by ERM
using USEPA investigation data from 1998 and 2003.

Bedrock strike (N62°E) and dip (27°NW) based upon
Bird and Conger (2002).

300 150 0 300 Feet

Bedrock Topography

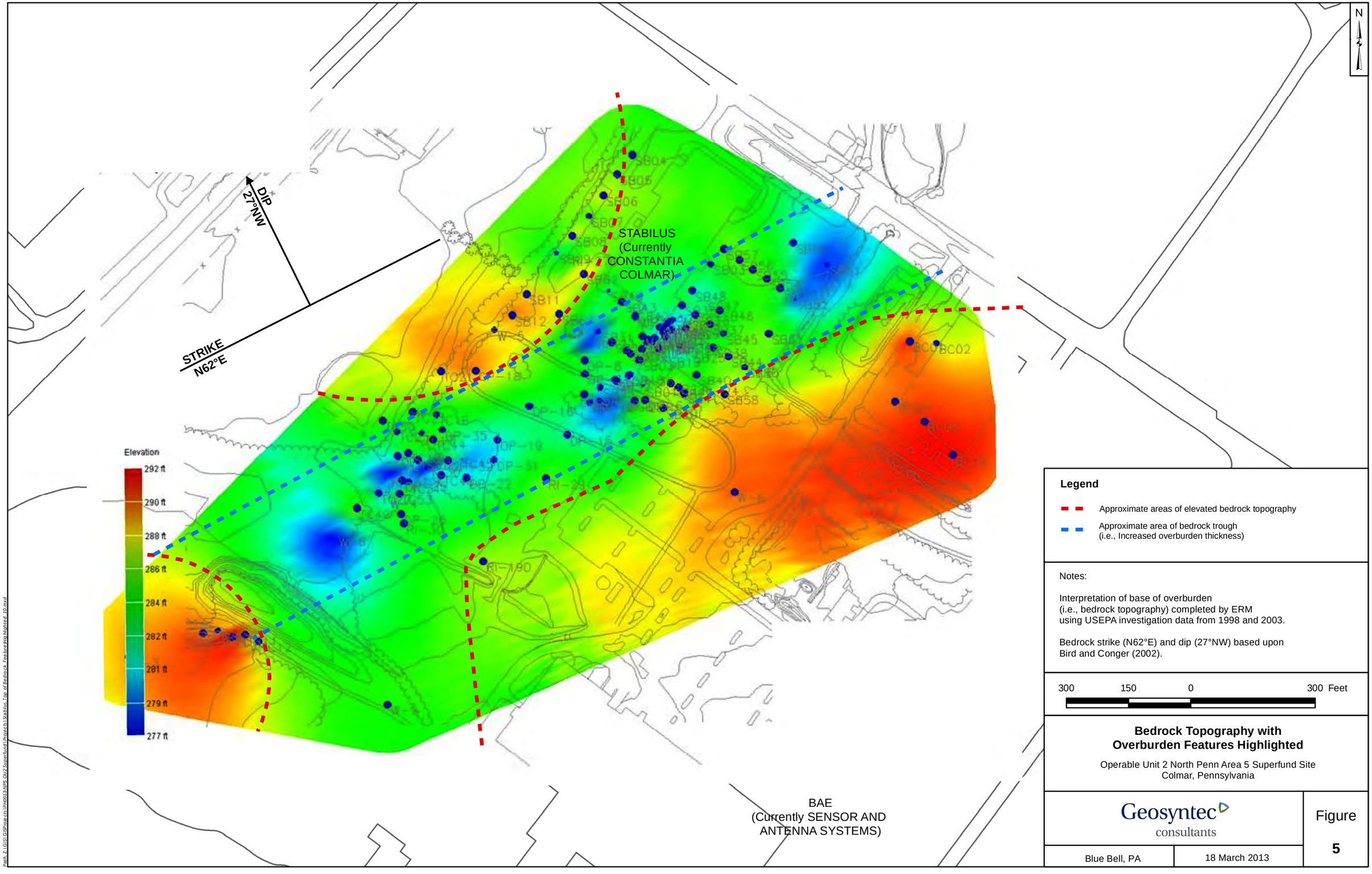
Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania

Geosyntec consultants

Blue Bell, PA | 18 March 2013

Figure **4**

Path: Z:\GIS\GISProjects\PH0013-NPS_OU2 Superfund\Projects\Stabilus_Top of Bedrock_10.mxd



Legend

- Approximate areas of elevated bedrock topography
- Approximate area of bedrock trough (i.e., Increased overburden thickness)

Notes:

Interpretation of base of overburden (i.e., bedrock topography) completed by ERM using USEPA investigation data from 1998 and 2003.

Bedrock strike (N62°E) and dip (27°NW) based upon Bird and Conger (2002).

300 150 0 300 Feet

Bedrock Topography with Overburden Features Highlighted

Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania

Geosyntec consultants

Blue Bell, PA | 18 March 2013

Figure **5**

Path: Z:\GIS\GISProjects\PH0013-NPS_OU2 Superfund\Projects\Stabilus Top of Bedrock Feature#sHighlighted_10.mxd

STABILUS
(Currently
CONSTANTIA
COLMAR)

LOADING DOCK
AREA

100

7600

1000

500

1000

SEWER
AREA

BAE
(Currently SENSOR AND
ANTENNA SYSTEMS)

POND
AREA

N

Legend

- Approximate Areas of Elevated Bedrock Topography
- Approximate Area of Bedrock Trough (i.e., Increased Overburden Thickness)
- TCE isoconcentrations from Direct Push sampling, May 2003. Contours shown from Supplemental II RI/FS (USEPA, 2003).
- Elevation Contours

Notes:

Bedrock strike (N62°E) and dip (27°NW) based upon Bird and conger (2002).

150 75 0 150 Feet

Operable Unit 2 Overburden Groundwater and Bedrock Trough Location Map

Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania

Geosyntec consultants

Blue Bell, PA | 18 March 2013

Figure 6

Path: Z:\GIS\GIS Projects\PH0013-NP5 OU2 Superfund\Projects\OB TCE & Bedrock Trough_10.mxd

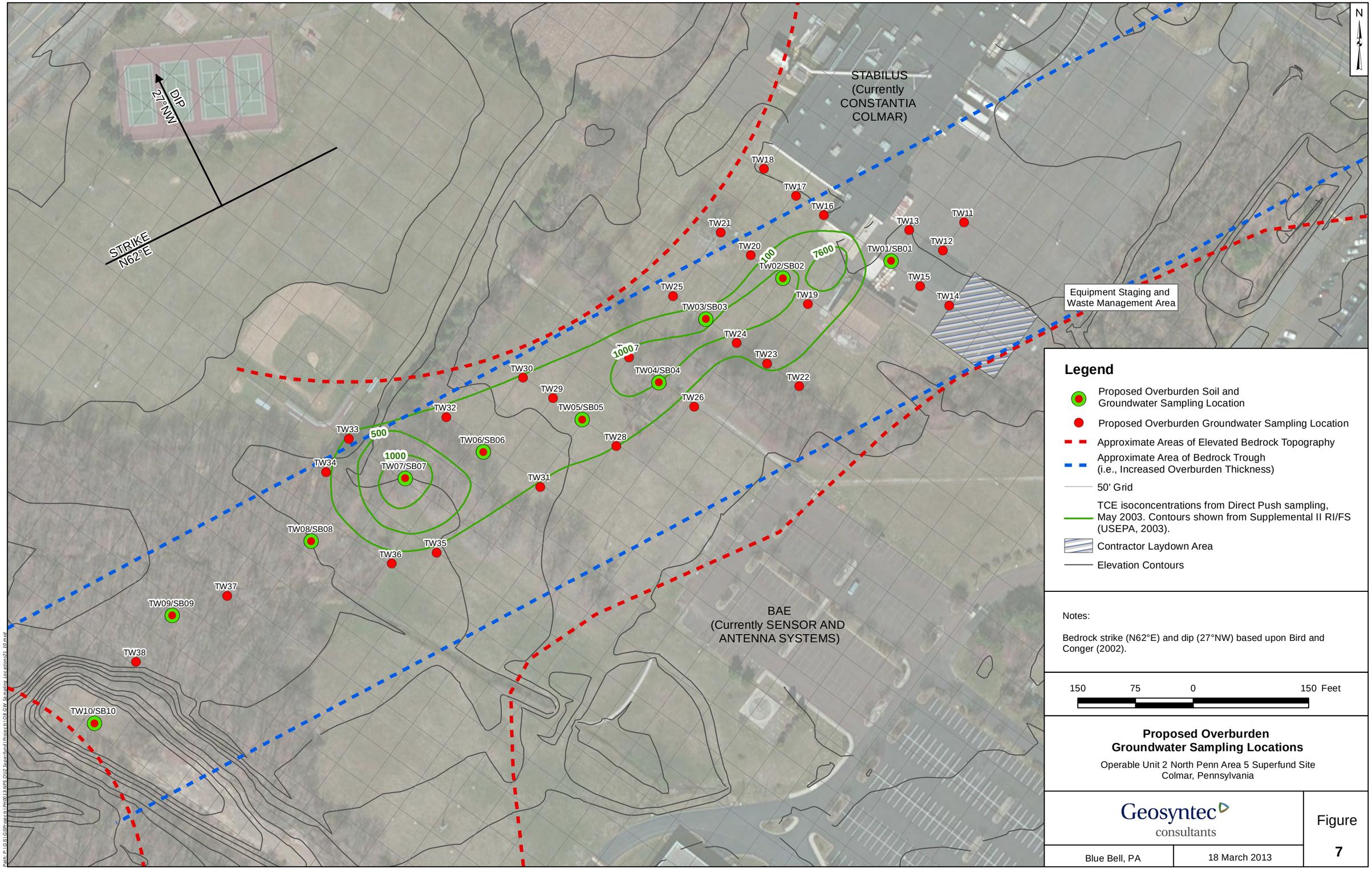

DIP
27° NW
STRIKE
N62°E
N
STABILUS
(Currently
CONSTANTIA
COLMAR)
BAE
(Currently SENSOR AND
ANTENNA SYSTEMS)
Equipment Staging and
Waste Management Area
TW01/SB01
TW02/SB02
TW03/SB03
TW04/SB04
TW05/SB05
TW06/SB06
TW07/SB07
TW08/SB08
TW09/SB09
TW10/SB10
TW11
TW12
TW13
TW14
TW15
TW16
TW17
TW18
TW19
TW20
TW21
TW22
TW23
TW24
TW25
TW26
TW27
TW28
TW29
TW30
TW31
TW32
TW33
TW34
TW35
TW36
TW37
TW38
100
500
1000
7600
Legend
Proposed Overburden Soil and Groundwater Sampling Location
Proposed Overburden Groundwater Sampling Location
Approximate Areas of Elevated Bedrock Topography
Approximate Area of Bedrock Trough (i.e., Increased Overburden Thickness)
50' Grid
TCE isoconcentrations from Direct Push sampling, May 2003. Contours shown from Supplemental II RI/FS (USEPA, 2003).
Contractor Laydown Area
Elevation Contours
Notes:
Bedrock strike (N62°E) and dip (27°NW) based upon Bird and Conger (2002).
150 75 0 150 Feet
Proposed Overburden
Groundwater Sampling Locations
Operable Unit 2 North Penn Area 5 Superfund Site
Colmar, Pennsylvania
Geosyntec consultants
Blue Bell, PA
18 March 2013
Figure
7
Path: P:\GIS\GISProjects\PH0913\NPS Ou2 Superfund\Projects\OB GW Sampling Locations21_10.mxd

FIGURE 8: **Pre-Design Investigation Project Team Organization**
Operable Unit 2 North Penn Area 5 Superfund Site

Geosyntec consultants

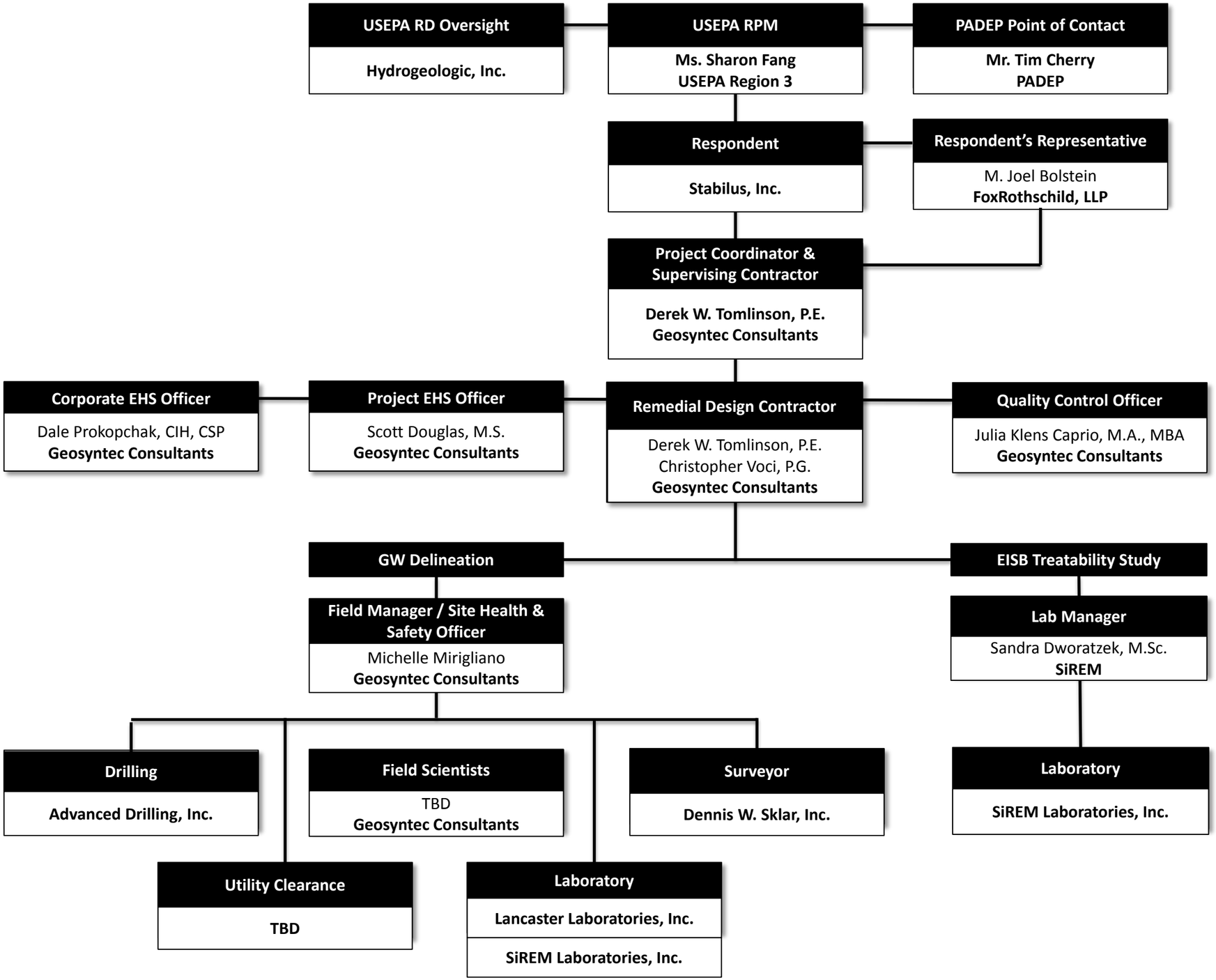
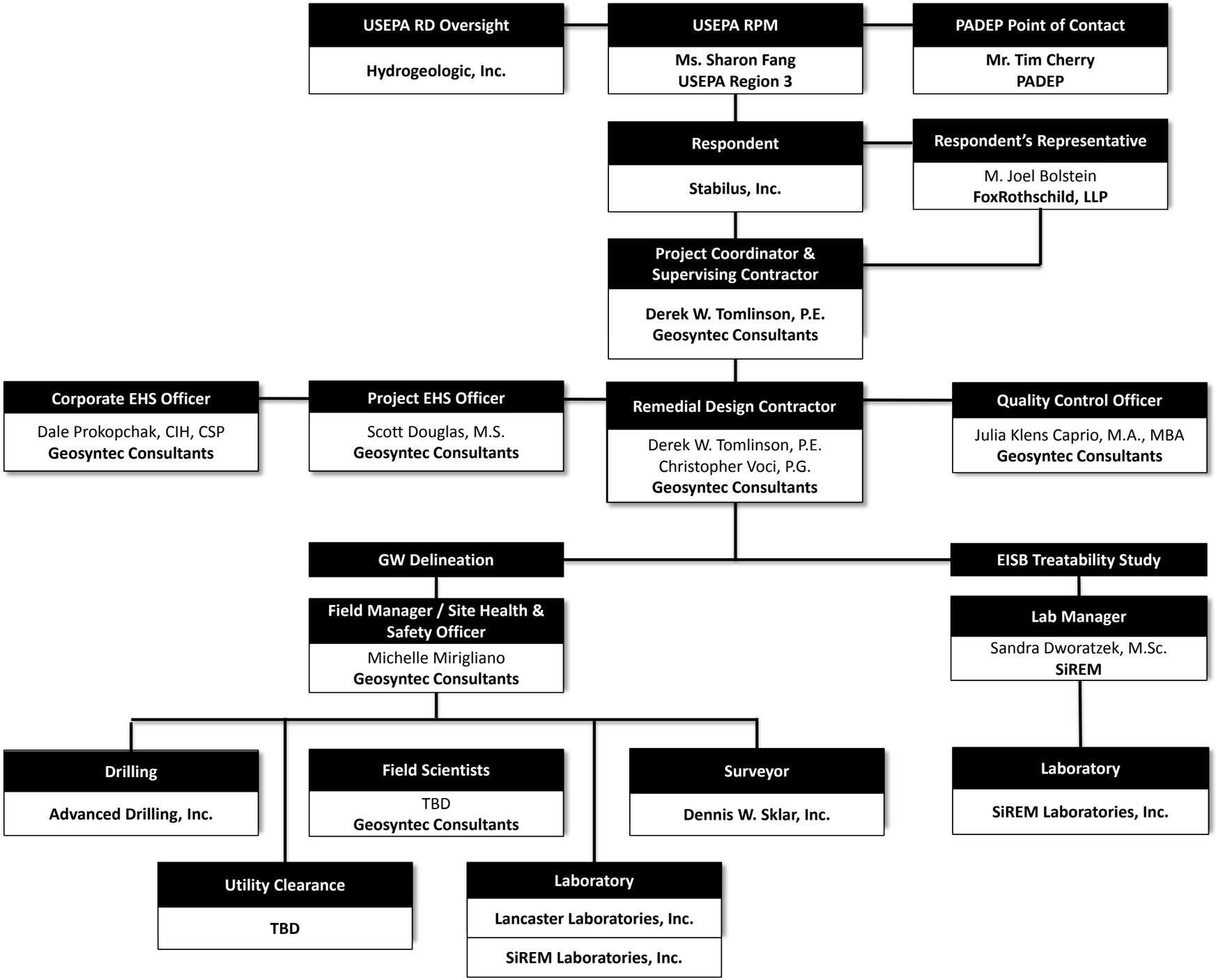


FIGURE 8: **Pre-Design Investigation Project Team Organization**
Operable Unit 2 North Penn Area 5 Superfund Site

Geosyntec consultants



APPENDIX A

Prior Groundwater and Soil Delineation Isoconcentration Contours

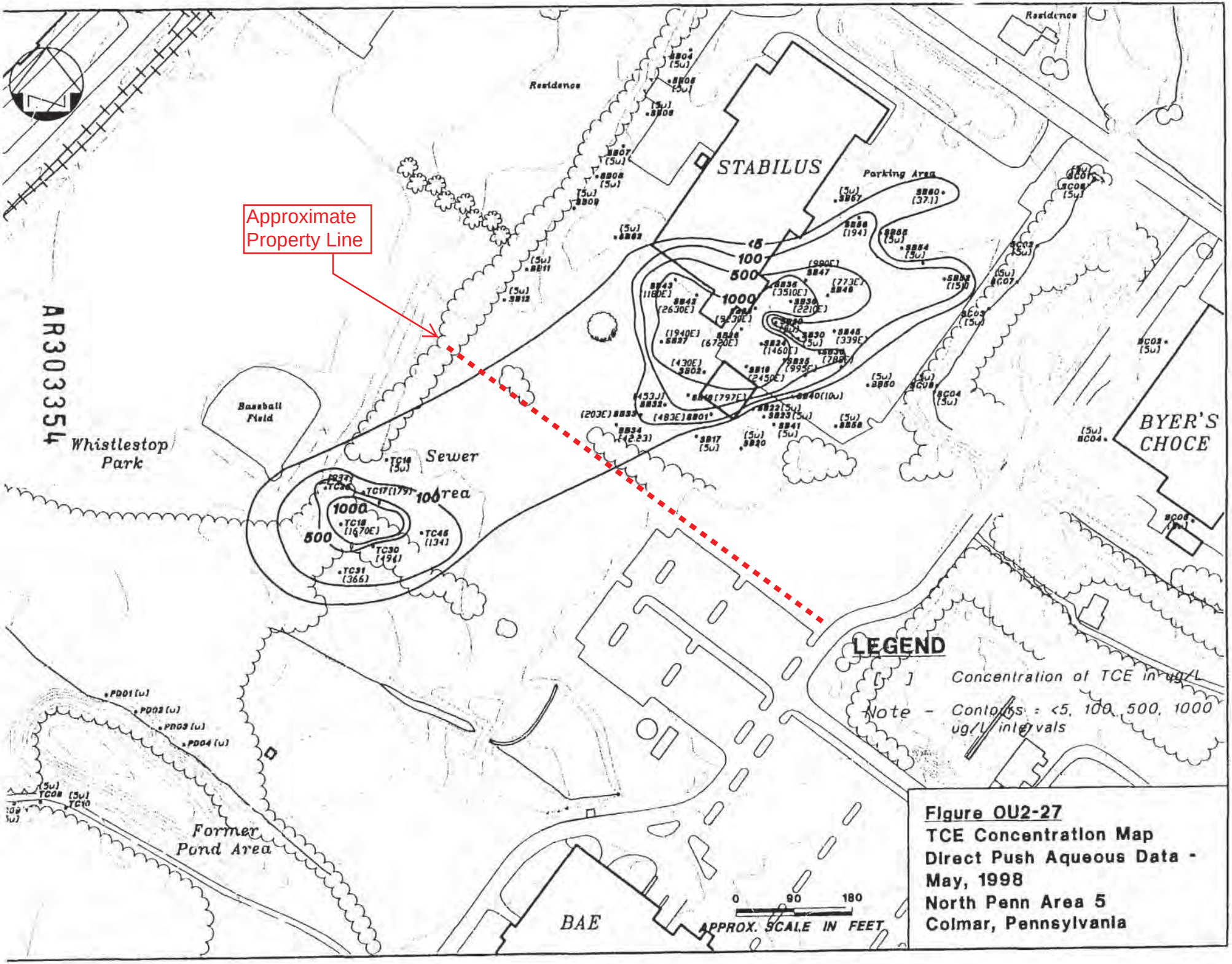
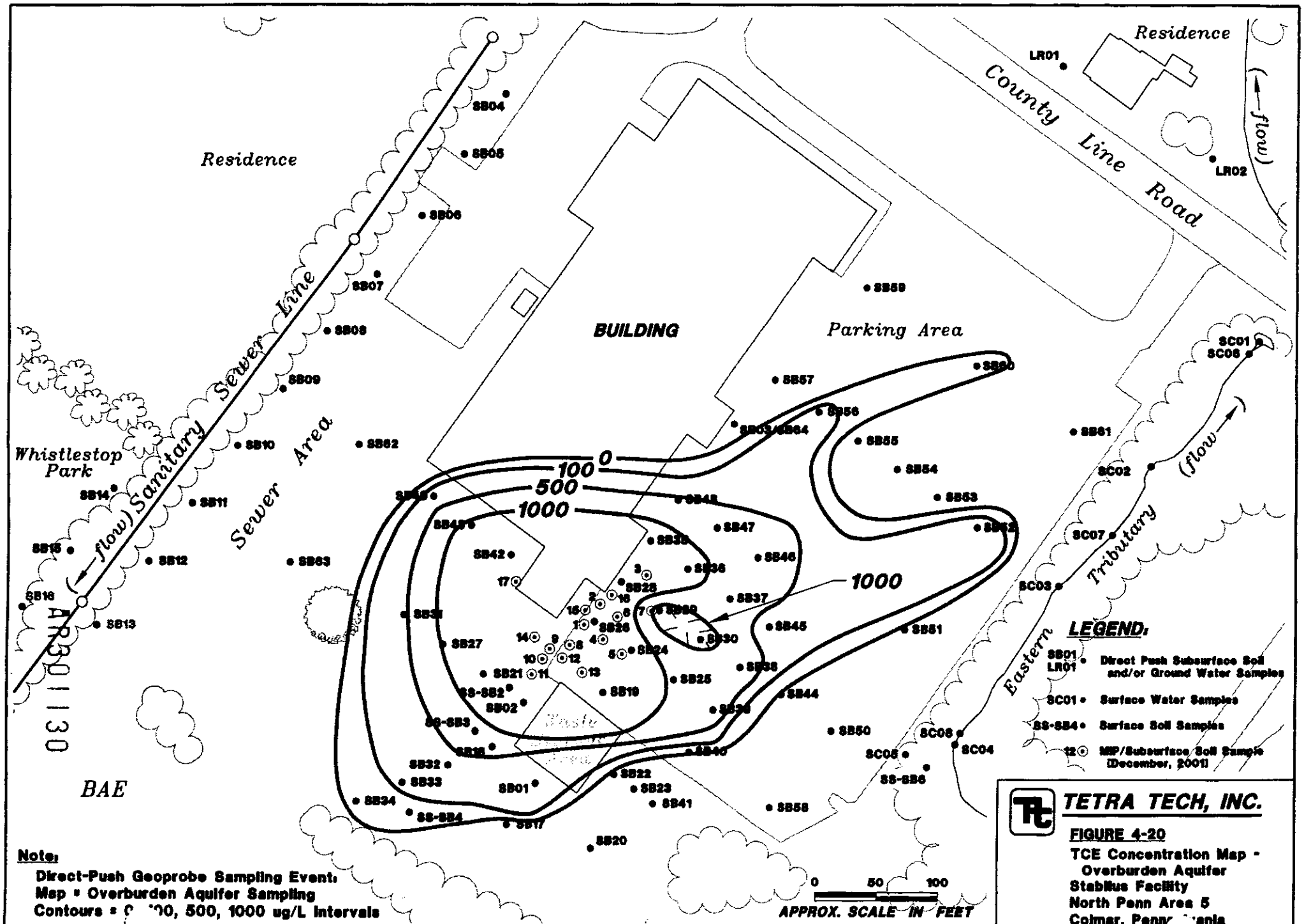
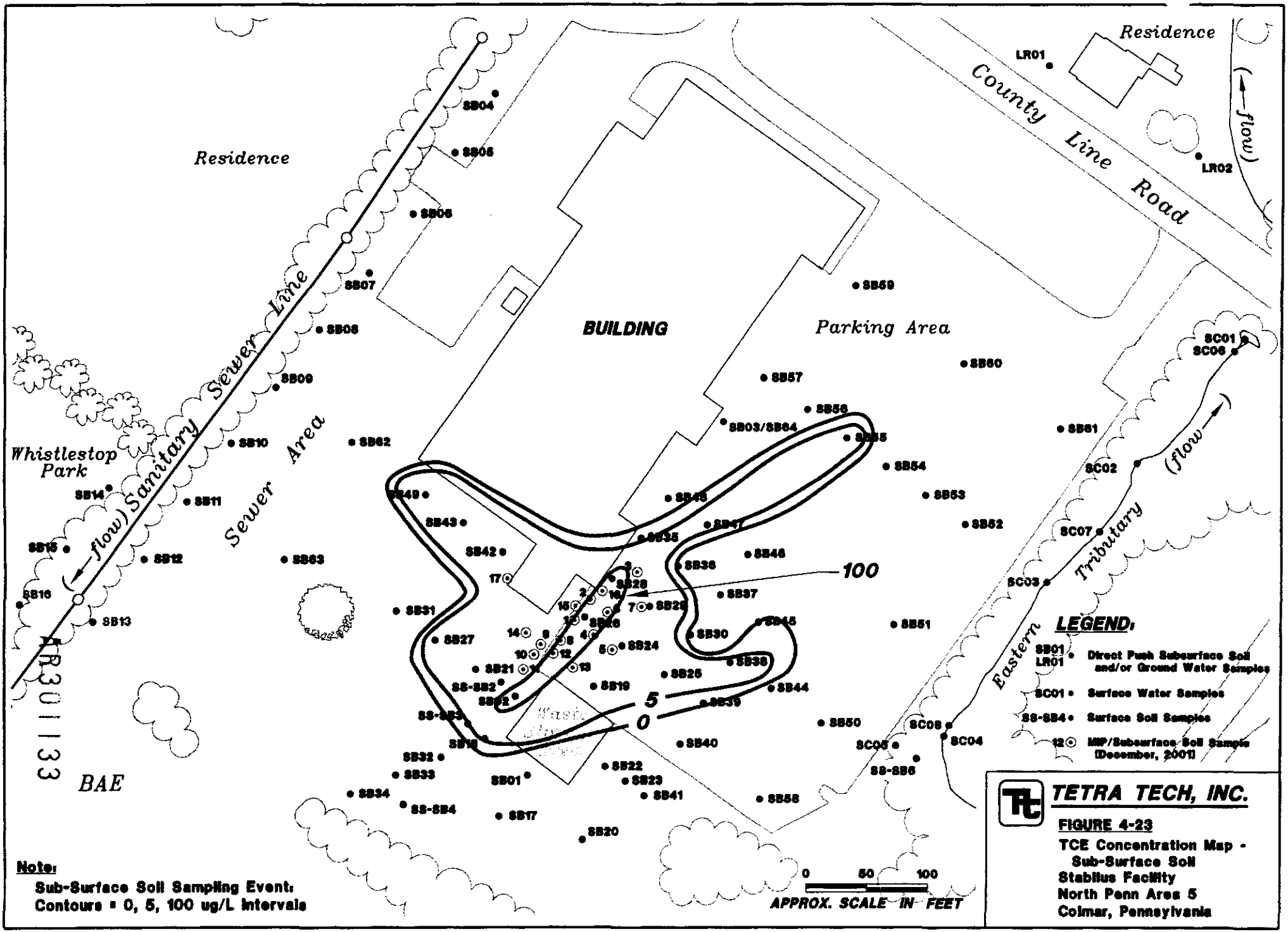


Figure OU2-27
TCE Concentration Map
Direct Push Aqueous Data - May, 1998
North Penn Area 5
Colmar, Pennsylvania



Note:

Direct-Push Geoprobe Sampling Event.
Map = Overburden Aquifer Sampling
Contours = 0, 100, 500, 1000 ug/L Intervals


Residence
LR01
LR02
County Line Road
(flow)
Residence
SB04
SB05
SB06
SB07
SB08
SB09
SB10
SB11
SB12
SB13
SB14
SB15
SB16
SB62
SB63
BUILDING
Parking Area
SB59
SB60
SB57
SB56
SB03/SB64
SB55
SB54
SB53
SB52
SB61
SC01
SC06
SC02
SC07
SC03
SC08
SC04
SC05
SB51
SB50
SS-SB5
SB49
SB43
SB42
SB35
SB47
SB48
SB36
SB37
SB45
SB30
SB38
SB44
SB39
SB40
SB41
SB58
SB31
SB27
SB21
SS-SB2
SB26
SB24
SB25
SB19
SB18
SB32
SB33
SB34
SS-SB3
SS-SB4
SB01
SB22
SB23
SB17
SB20
100
5
0
Whistlestop Park
Sewer Area
(flow) Sanitary Sewer Line
Eastern Tributary
(flow)
BAE
R3011133
LEGEND:
SB01 LR01 • Direct Push Subsurface Soil and/or Ground Water Samples
SC01 • Surface Water Samples
SS-SB4 • Surface Soil Samples
12 ⊙ MIP/Subsurface Soil Sample (December, 2001)
0 50 100
APPROX. SCALE IN FEET
TETRA TECH, INC.
FIGURE 4-23
TCE Concentration Map - Sub-Surface Soil
Stabilus Facility
North Penn Area 5
Colmar, Pennsylvania
Note:
Sub-Surface Soil Sampling Event:
Contours = 0, 5, 100 ug/L Intervals

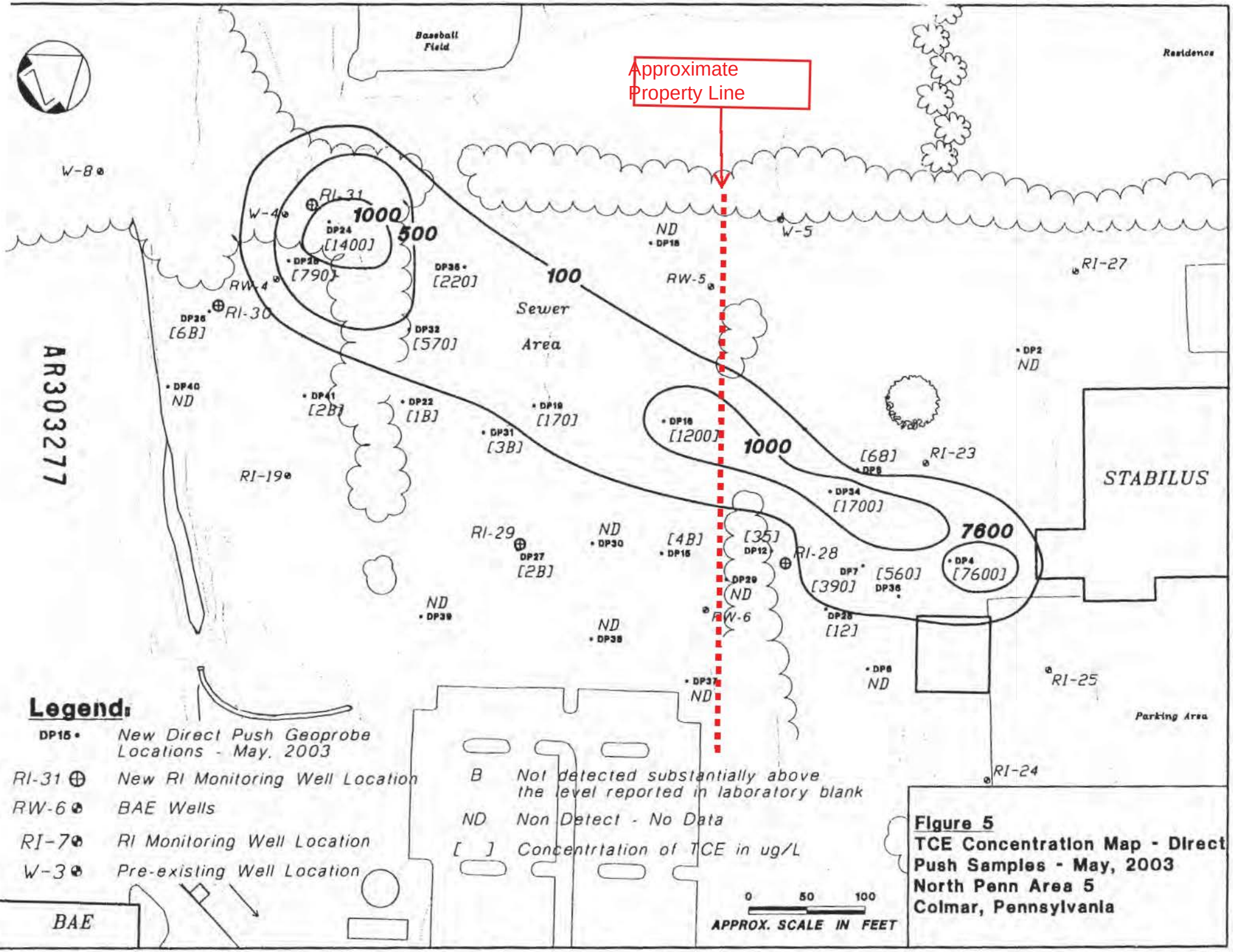
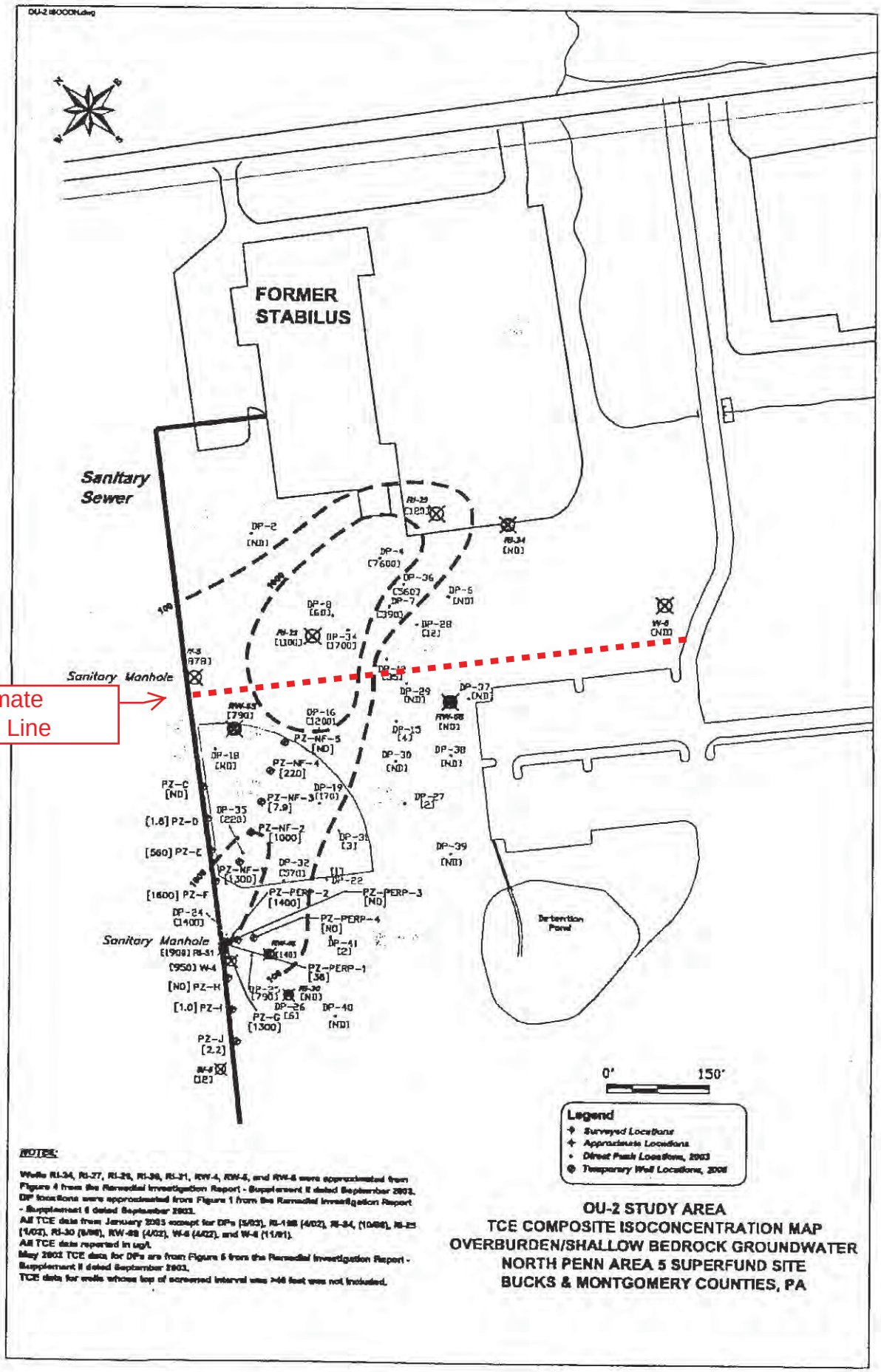


Figure 5
TCE Concentration Map - Direct Push Samples - May, 2003
North Penn Area 5
Colmar, Pennsylvania



NOTES:

Wells RI-34, RI-27, RI-25, RI-36, RI-31, RW-4, RW-5, and RW-6 were approximated from Figure 4 from the Remedial Investigation Report - Supplement II dated September 2003.
DP locations were approximated from Figure 1 from the Remedial Investigation Report - Supplement II dated September 2003.
All TCE data from January 2003 except for DPs (5/03), RI-19B (4/02), RI-34, (10/00), RI-25 (1/03), RI-30 (5/00), RW-6B (4/02), W-6 (4/02), and W-6 (11/01).
All TCE data reported in ug/l.
May 2003 TCE data for DPs are from Figure 5 from the Remedial Investigation Report - Supplement II dated September 2003.
TCE data for wells whose top of screened interval was >40 feet was not included.

OU-2 STUDY AREA
TCE COMPOSITE ISOCONCENTRATION MAP
OVERBURDEN/SHALLOW BEDROCK GROUNDWATER
NORTH PENN AREA 5 SUPERFUND SITE
BUCKS & MONTGOMERY COUNTIES, PA

APPENDIX B

Health and Safety Plan (HASP)

Stabilus, Inc
120 Tulip Drive
Gastonia, NC 28052

HEALTH AND SAFETY PLAN

Operable Unit 2 North Penn Area 5 Superfund Site
Pre-Design Investigation
Colmar, Pennsylvania

Prepared by

Geosyntec consultants

engineers | scientists | innovators

1787 Sentry Parkway West
Building 18, Suite 120
Blue Bell, PA 19422

Project Number: PH0013

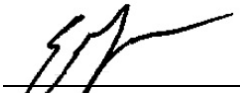
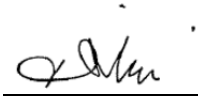
18 March 2013

TABLE OF CONTENTS

1. SIGNATURES

1.1 Preparers and Reviewers

This HASP, which must be maintained on Site when field work is being performed, addresses the health and safety hazards of each phase of Site operation, including the procedures and equipment required for worker protection. Only the Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Environmental Health and Safety Coordinator (EHSC), and Project Manager. The SHSO must initial any change made to the HASP at the relevant section. Major amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section 3 and in Appendix A. This HASP must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by:		7 March 2013
	SHSO – Michelle Mirigliano	Date
Reviewed by:		8 March 2013
	EHSC – Ersin Yalcin	Date
Approved by:		18 March 2013
	Project Coordinator / Geosyntec Project Manager – Derek Tomlinson	Date
Approved by: (as needed)		18 March 2013
	Geosyntec Project Director – Chris Voci	Date

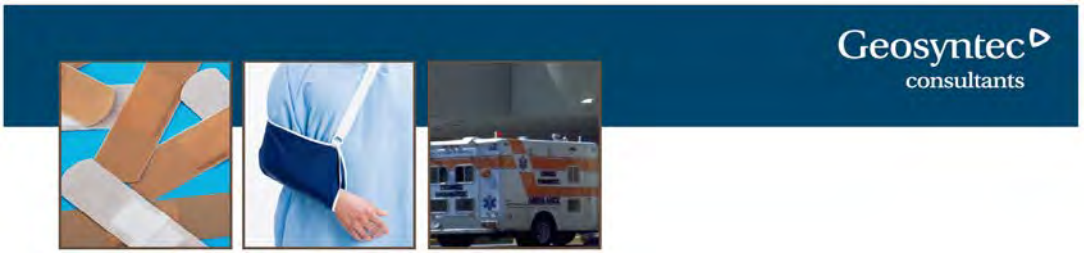
Copy Cover Sheet to: EHSC

This HASP has been given to the following subcontractor(s) in accordance with the Occupational Safety and Health Administration (OSHA) HAZWOPER Standard, per Chapter 29 of Code of Federal Regulations (CFR), Subsection 1910.120.

Subcontractor: _____ Representative: _____ Date: _____

Subcontractor: _____ Representative: _____ Date: _____

Subcontractor: _____ Representative: _____ Date: _____



Instructions for Injury Response

IF LIFE THREATENING: CALL 911

If not life threatening but requiring emergency care:

Seek immediate medical attention at the hospital/facility that provides emergency care shown on **FIGURE 1A**.

- **Once the emergency situation has stabilized, follow the "Instructions for Incident Reporting" included in this HASP.**

If Not Requiring Emergency Care:

Manager/Supervisor calls the EHS Department at **(804) 349-8067 (Dale Prokopchak)** or **(404) 435-4722 (Ersin Yalcin)** to discuss appropriate medical attention (even if he/she thinks medical attention is not required). If professional care is needed, contact **WorkCare** at **(888) 449-7787** to get assistance.

- **Present the medical care provider with the TEAR-OUT FORMS *("Instructions to Medical Provider"* and *"Physical Status for Return to Work"*) included in this HASP.**
- **Follow the *"Instructions for Incident Reporting"* included in this HASP within one hour.**

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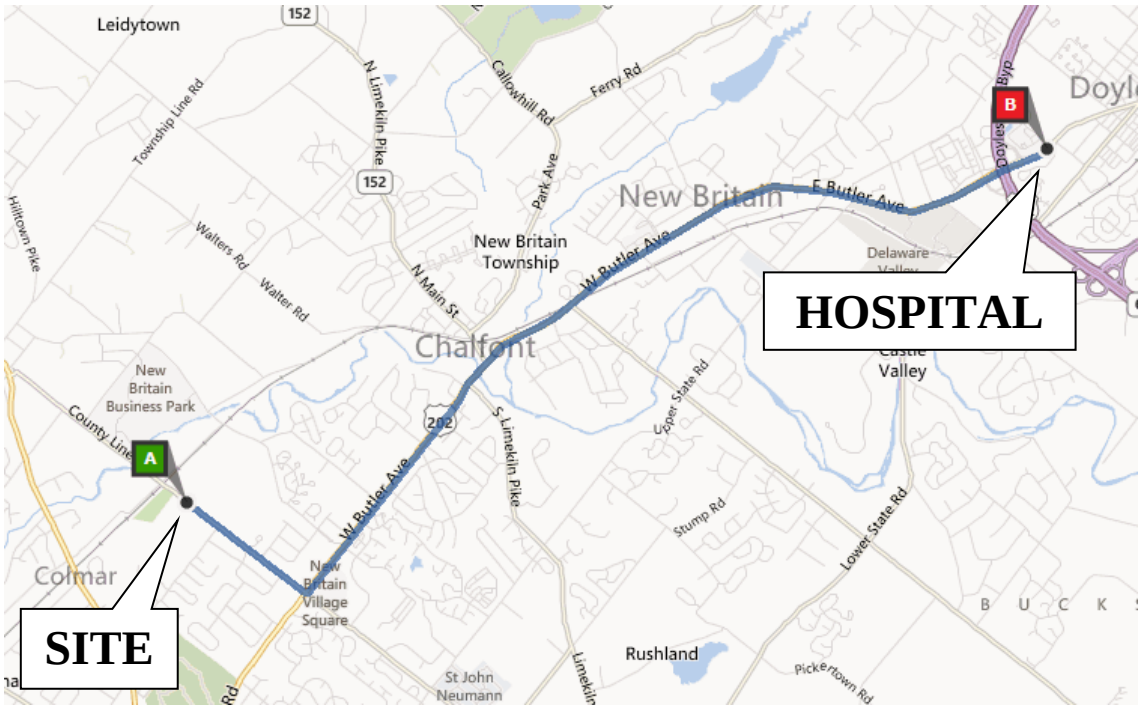
FIGURE 1A

ROUTE TO HOSPITAL

Doylestown Hospital
215-345-2200
595 West State Street
Doylestown, PA



Written Directions to Hospital from Site:

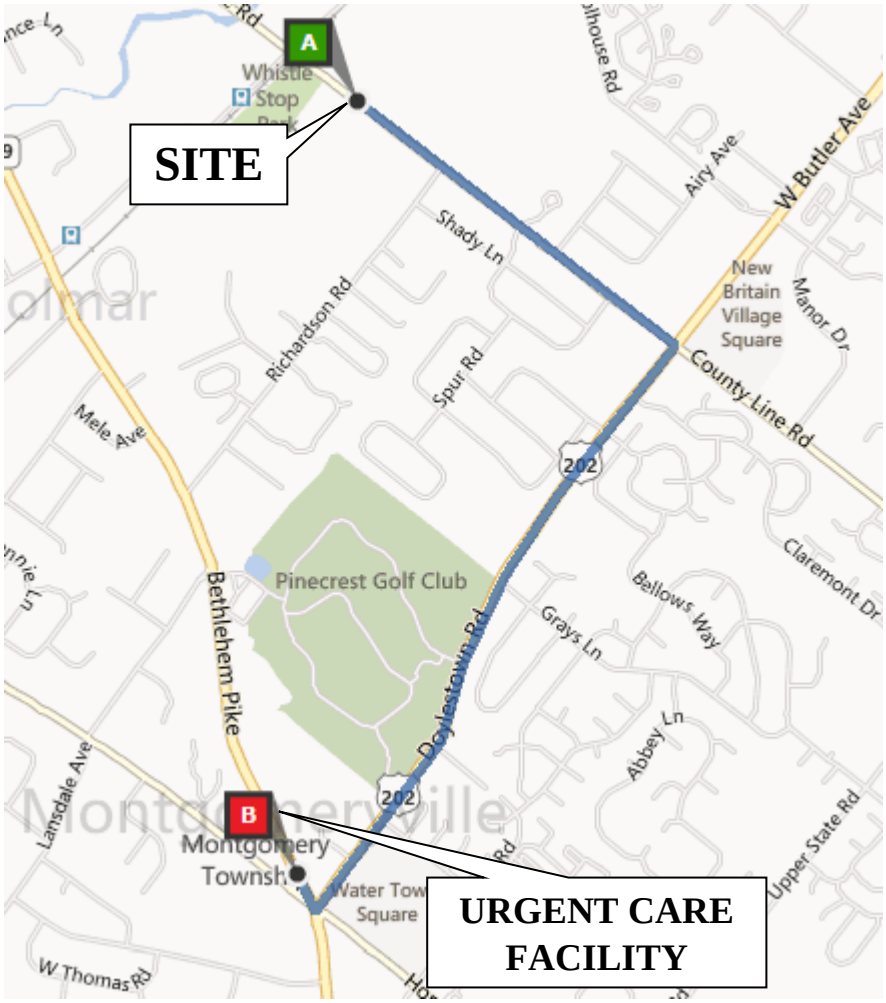
6.5 miles, 12 minutes driving

Depart 92 County Line Road (make right) toward Richardson Road
Turn left onto US-202/W. Butler Pike (0.9 miles)
Keep straight on US-202 North (4.9 miles)
Keep straight onto West State Street (0.1 miles)
Make U-turn at Progress Drive (0.5 miles)
Arrive at 595 West State Street.

FIGURE 1B

ROUTE TO URGENT CARE FACILITY

Advanced Urgent Care
267-263-2298
721 Bethlehem Pike
Montgomeryville, Pa



Written Directions to Urgent Care Facility from Site:
2.5 miles, 4 minutes driving
Depart 92 County Line Road (make right) toward Richardson Road
Turn right onto US-202/W. Butler Pike (0.9 miles)
Turn right onto PA-309/Bethlehem Pike (1.5 miles)
Arrive at 721 Bethlehem Pike.

FIGURE 2

SITE MAP

EMERGENCY RESPONSE PROCEDURES

- The Site Health and Safety Officer (SHSO), or designated alternate, should be immediately notified via the on-site communication system. The SHSO assumes control of the emergency response.

- If applicable, the SHSO must immediately notify off-site emergency responders (i.e., fire department, hospital, police department, etc.) and must inform the response team of the nature and location of the emergency on Site.

- If applicable, the SHSO calls for evacuation of the Site. Site workers should move to their respective refuge stations using the evacuation routes provided on the Site Map (Figure 2).

- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.

- If a worker is injured, the procedures presented in "Instructions for Injury Response", located in the front of this HASP, must be implemented immediately.

- After an incident has stabilized, the procedures presented in "Instructions for Incident Reporting", located in the front of this HASP, must be followed.

EMERGENCY RESPONSE CONTACT INFORMATION

Contact	*Telephone Numbers*		*Date of Pre-Emergency Notification (if required)*
	Office	*Alternate (Type)*	
Fire Department – Chalfont	911	(215) 822-9685 (direct)	
Police Department – Chalfont	911	(215) 348-3524 (direct)	
Hospital - Doylestown Hospital	911	(215) 345-2200 (direct)	
Project Coordinator - Derek Tomlinson	(267) 464-2800 ext 9025	(267) 218-0835 (cell)	
Project Director - Chris Voci	267-464-2800 ext 9024	(609) 613-0998 (cell)	
Director of Environment, Health & Safety – Dale Prokopchak	(804) 332-6376	(804) 349-8067 (cell)	
Environmental, Health & Safety Coordinator – Scott Douglas	(609) 493-9002	(617) 359-1465 (cell)	
Utility Emergencies	811		
EPA RPM – Sharon Fang	(215) 814-3018		
PADEP – Tim Cherry	(484) 250-5728		
Stabilus Point of Contact: Joel Bolstein	(215) 918-3555	(267) 880-2655 (cell)	
Site Contact: Constantia-Colmar, Inc. Richard Klecker	(215) 997-6222	(267) 718-9421	

Dear Medical Provider:

On behalf of Geosyntec Consultants/MMI Engineering, you are authorized to evaluate and treat the above Geosyntec/MMI employee today for an alleged work-related injury or illness.

Employee Name: _____
Alleged Injury: _____
Date of Alleged Injury: _____
Date of Medical Evaluation: _____

Geosyntec/MMI strives to reduce OSHA recordables; therefore, ***please do not prescribe or dispense prescription medications if OTC medications or non-prescription strength can be used*.** It is our primary interest to ensure this employee returns to work full duty. If a full duty release is not possible, Geosyntec/MMI may be able to find light duty for the **employee**; ***unless it is unavoidable, please do not prescribe lost time.*** We would appreciate it if you would complete the attached form "Physical Status for Return to Work", or a similar form, to assist us in evaluating this employee's work capabilities.

- Please fax a copy of all medical paperwork and "Physical Status for Return to Work Form" to Dale Prokopchak at (804) 332-6732.
- Invoices and supporting medical records should be mailed to:

  Human Resources Department
  Geosyntec Consultants
  900 Broken Sound Parkway, NW, Suite 200
  Boca Raton, FL 33487
  Phone: 561.922.1112
  Fax: 561.922.1101

Thank you for your assistance.

Very truly yours,

Dale Prokopchak, CIH, CSP
Director of Environmental Health and Safety

Geosyntec consultants

PHYSICAL STATUS FOR RETURN TO WORK
PLEASE FAX COMPLETED FORM TO DALE PROKOPCHAK AT (804) 332-6732

Employee Name _____ Date of Injury/Illness _____

TO BE COMPLETED BY TREATING PHYSICIAN

Diagnosis _____

I saw and treated this patient on (date) _____ and:

__ Release the patient to full duty with no limitations on (date) _____

__ Patient may return to work with the following limitation on (date) _____ and may work an 8 hr. shift unless specified otherwise.

LIFTING CAPACITY

__ Occasional lifting (10 lbs. max.) and lifting and carrying occasionally. Walking and standing occasionally.

__ Occasional lifting (20 lbs. max.). Significant walking, standing; or sitting with pushing and pulling with arms or legs.

__ Occasional lifting (50 lbs. max.) with frequent lifting and/or carrying up to 25 pounds.

OTHER ACTIVITIES

		SINGLE DURATION					IN AN 8 HOUR DAY PATIENT MAY DO				
LIMITATION	NO LIMITATION	< 1/2 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	6-8 hr
SIT											
STAND											
WALK											
USE RIGHT HAND											
USE LEFT HAND											

	NO LIMITATION	FREQUENTLY (31%-60%)	OCCASIONALLY (1%.-30%)	NEVER
BEND				
SQUAT				
CLIMB				
REACH OVERHEAD		WEIGHT LIMIT	WEIGHT LIMIT	
REACH SHOULDER		WEIGHT LIMIT	WEIGHT LIMIT	
PUSHING/PULLING		WEIGHT LIMIT	WEIGHT LIMIT	

Other instructions or limitations:

_____

_____

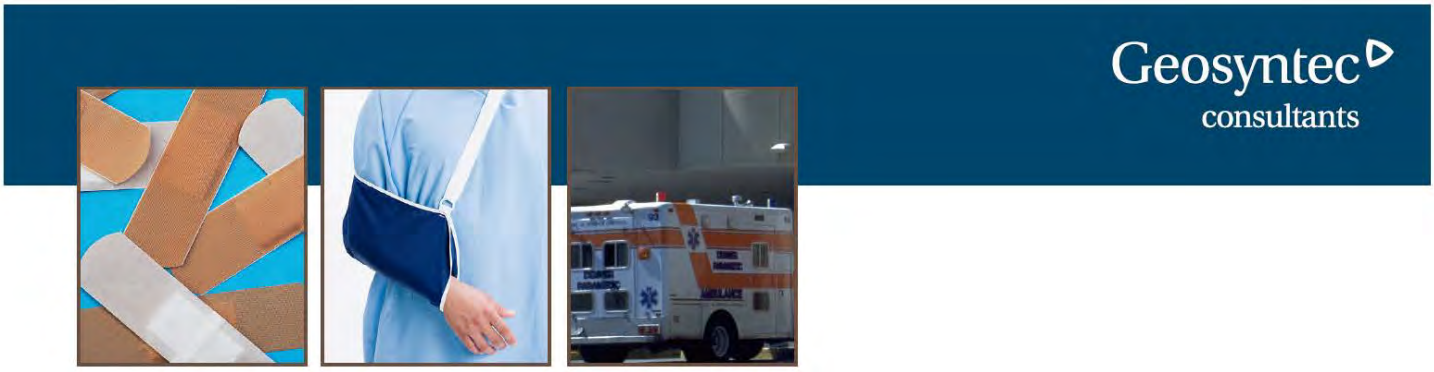
Estimated length of time of modified duty: _____

__ These restrictions are in effect until (date) _____ or until patient is reevaluated on (date) _____

__ Patient is totally incapacitated at this time. Patient will be reevaluated on (date) _____

Physician Signature _____ Date _____

ADDITIONAL NOTES:



Instructions for Incident Reporting

Once an emergency situation has been stabilized, or within one hour of a non-emergency incident:

Manager/Supervisor calls the EHS Department at **(804) 349-8067** or **(404) 435-4722**—to discuss appropriate medical attention. If unable to contact the EHS Department within one (1) hour, a detailed voicemail with information about the incident must be provided and if non-emergency professional care is needed, contact **WorkCare** at **(888) 449-7787** to get assistance.

- Within 24 hours, the Manager/Supervisor completes a draft of the "Manager's Report of Incident", located in this HASP and on the EHS webSite, and sends to HR at (561) 922-1101.
- Manager/Supervisor forwards the finalized paperwork within 48 hours to both EHS (dprokopchak@geosyntec.com); fax (804) 332-6732 and HR; fax (561) 922-1101 for review, documentation, and implementation into our case management program.
- Contractors are responsible for compliance with their internal safety procedures regarding Incident Reporting. Geosyntec will document the Contractor's incident in their Project Logbook.
- In the event of a vehicle accident that does not involve injuries, please follow the procedures outlined in EHS 105—Driver Safety.

Contact Information

Dale Prokopchak: office: 804.332.6376 | cell: 804.349.8067 | fax: 804.332.6732 | dprokopchak@geosyntec.com
Ersin Yalcin: office: 678.202.9552 | cell: 404.435.4722 | fax: 678.202.9501 | eyalcin@geosyntec.com

DRIVER'S REPORT OF ACCIDENT – PAGE 1

Driver's Report of Accident

Do not argue at the scene of the accident. Be courteous and show your license willingly.

Your Vehicle

Name of Driver _____

Odometer Reading _____

Vehicle I.D. No. _____

License Plate No. _____ State _____

Place of Accident _____

_____

City/State _____

Direction of Travel _____

Speed _____

Other Vehicle

Name of Driver _____

Address _____

_____

Phone No. _____

Driver's License No. _____

License Plate No. _____ State _____

Vehicle I.D. Number _____

Year/Model _____

Owner of Vehicle _____

Address of Owner _____

_____

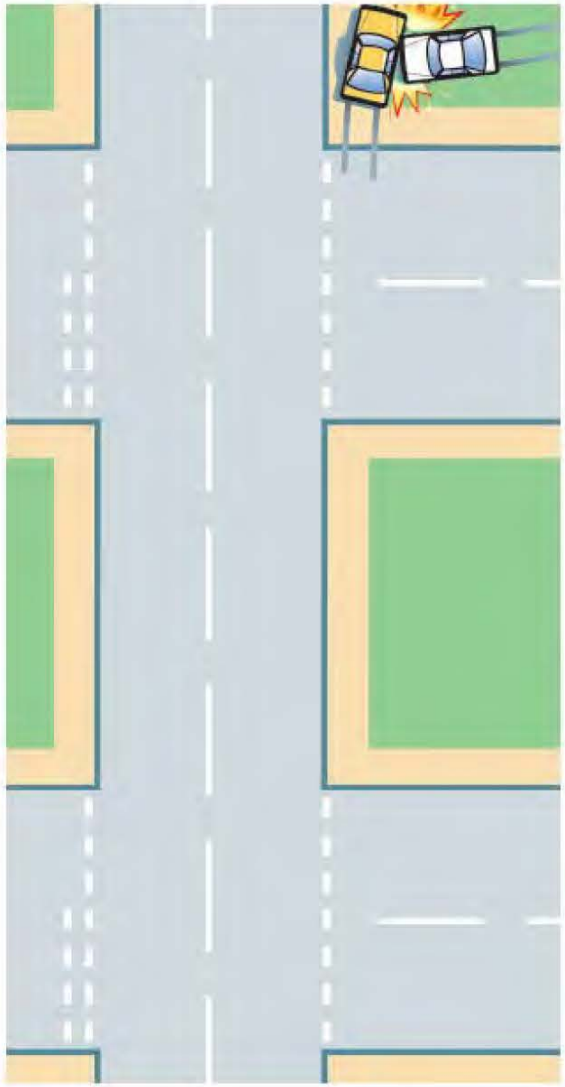
Insured by _____

Direction of Travel _____

Approximate Speed _____

Diagram of Accident

Using the diagram below, show exact relationship of roadways and vehicles at the time of the accident. (Indicate North) Show measurements if possible (identify your vehicle as #1, other vehicles as #2, #3, etc.)



What to do in Case of a **Vehicle Accident**

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DRIVER'S REPORT OF ACCIDENT – PAGE 2

Here is What to do

1. Take precautions necessary to protect the scene of the accident from further accidents.
2. Call police immediately, if someone is injured, request medical assistance. In case of fire, request fire department.
3. If there are any injuries, follow the requirements of the injury, illness, near miss procedure
4. Be courteous. Answer police questions. Give identifying information to the other party involved, but make no comments about assuming responsibility. Check the glove box for insurance information on your rental car.
5. Complete this ACCIDENT REPORT FORM. You will need this information later for state and insurance reports.
6. Report the accident to your immediate supervisor as soon as possible. The supervisor will send the completed form to Emil Uglesic in the Oakland Office: phone (510) 285-2718; fax (510) 836 -3037. Emil will contact Marsh (the insurance carrier). If the vehicle accident results in an injury to a Geosyntec employee that requires medical attention, the supervisor will notify appropriate personnel within their department and EHS.
7. Take photographs of the damage if it is safe to do so.
8. Do not leave the scene of the accident, until police have arrived or you're being transported by rescue.

Description of Accident

Date _____ Time _____ ○ am ○ pm

Road Condition _____

Time of Day
(check one) ○ Daylight ○ Dawn/Dusk ○ Night

Weather Condition
(check one) ○ Foggy ○ Cloudy ○ Clear

Road Surface
(check one) ○ Wet ○ Damp ○ Dry

Description _____

_____

Driver's Signature _____

Employer
(check one) ○ Geosyntec Consultants ○ MMI

Branch Location _____

Branch Phone Number _____

Witnesses

1. Name _____

Address _____

_____

Phone _____

2. Name _____

Address _____

_____

Phone _____

Police Investigation

Name of Officer _____

Report Number _____

Name of Police Agency _____

Was Summons Issued ○ Yes ○ No

Injured Persons

1. Name _____ **DOB:** _____

Address _____

_____

Nature of Injury _____

2. Name _____ **DOB:** _____

Address _____

_____

Nature of Injury _____

Damage to Property

1. Owner _____

Address _____

_____

Damaged _____

Property _____

Extent of Damage _____

_____

_____

2. Owner _____

Address _____

_____

Damaged _____

Property _____

Extent of Damage _____

_____

_____

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MANAGER'S REPORT OF INCIDENT

1. Seek immediate medical attention if the injury/illness is serious and/or life threatening.
2. Employee must report all incidents and near misses to their supervisor **immediately**
3. Supervisor must immediately notify the EHS Department at **(804) 349-8067** or **(404) 435-4722** with details of the incident, and discuss appropriate medical care for non-life threatening injury/illness. If unable to contact EHS, employee must call WorkCare at **(888) 449-7787** to get assistance with non-life threatening injury/illness care.

EMPLOYEE INFORMATION

Name: _____ Position: _____

Department #: _____ Employee #: _____ Phone #:_____

Supervisor Name: _____

FACTS OF INCIDENT

□ Injury □ Illness □ General Liability □ Near Miss Date and Time of Incident: _____

Date and Time Accident Reported: _____ To Whom: _____

Where did the incident occur (location name and street address)? _____

City: _____ State/Province_____ Zip/Postal Code: _____

County _____ Country: _____

What was the employee doing when the incident occurred? Name the tools, equipment or material the employee was handling and what he was doing with them. _____

_____

_____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). _____

_____

_____

NATURE OF INCIDENT

Describe incident and indicate body part affected if injury (e.g. cut on middle left finger). _____

_____

_____

Name object or substance that injured the employee._____

_____

Has any prior, related injury to affected area of body occurred while employed at Geosyntec/MMI? □ Yes □ No

MEDICAL ATTENTION GIVEN (check all that apply)

□ First Aid given by _____ Date/Time _____ Phone _____

□ Doctor's Name _____ Date/Time _____ Phone _____

Address _____

□ Hospital Name _____ Date/Time _____ Phone _____

Address _____

□ Released □ Admitted Length of Stay: _____

Did the employee go to an Emergency Room? □ Yes □ No

EMPLOYEE'S DESCRIPTION OF THE INCIDENT (IN OWN WORDS)

Describe incident and indicate body part affected (e.g. cut on middle left finger) and what you were doing when the incident occurred (be specific) _____

_____

_____

_____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). _____

_____

_____

_____

Employee's Signature _____ **Date**_____

ADDITIONAL INFORMATION (TO BE COMPLETED BY THE MANAGER)

Witnesses

Name: _____ Phone: _____

Name: _____ Phone: _____

What do you believe could be done to help prevent incidents of this type (be specific)? _____

_____

_____

_____

Any additional Comments _____

_____

_____

_____

Manager's Signature _____ **Date**_____ **Phone #:** _____

HR/EHS

OSHA Recordable?: □ Yes □ No □ Pending WC? □ Yes □ No

Days away from work: _____ Days of restricted work activity: _____ Date returned to work _____

HR Manager's Signature _____ **Date**_____

Comments: _____

EHS Manager's Signature _____ **Date**_____

Comments: _____

Manager must complete this form within 24 Hours of the incident and fax a copy of this report to Human Resources at (561) 922-1101 and EHS at (804) 332-6732

1.2 Site Workers

A pre-entry briefing conducted by the SHSO must be held prior to initiating the field work of this project. All sections of this HASP must be reviewed during this briefing. Any worker not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing. Tailgate meetings must be held at the beginning of each day by the SHSO to discuss important health and safety issues concerning tasks to be performed during that shift. Topics discussed in the tailgate meetings must be documented in a daily field log. Weekly Site health and safety audits must be performed and documented by the SHSO for projects lasting more than one week. After reading the HASP and attending a pre-entry briefing, Geosyntec employees must sign the following acknowledgment statement.

"I have read, understand, and agree with the information set forth in this HASP. I have also attended a pre-entry briefing. I agree to perform my work in accordance with this HASP."

Signature	**Printed Name**	**Date**

2. DISCLAIMER

This HASP was prepared in accordance with Geosyntec Consultants' Health and Safety Procedures for use by Geosyntec project staff. This plan complies with Geosyntec internal review procedures. Geosyntec does not endorse the use of this HASP by others. This document and its contents should not be used by firms other than Geosyntec or by persons other than Geosyntec employees without a thorough peer review by their health and safety managers. Should the work outlined in this HASP be executed by contractors other than Geosyntec, the HASP should be modified and reviewed to comply with such company's corporate health and safety procedures. In the event that a contractor other than Geosyntec executes this work, the contractor should complete independent analyses of hazards and mitigation measures, and should update all HASP tables, text, figures, and appendices prior to commencing work. Geosyntec assumes no responsibility for the accuracy, content, or health and safety of non-Geosyntec personnel during the implementation of the work in this HASP by other parties.

3. HASP AMENDMENTS

Over the course of this project, it is possible that the project-specific details and working conditions will change. This HASP shall be reviewed and amended as necessary to effectively describe the changing working conditions and to mitigate the potential health and safety issues that may arise during the project. Amendments to the HASP should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A.

AMENDMENT 1:

Date: _____ Project Manager: _____ EHSC: _____
Brief description of amendment:
_____
_____

AMENDMENT 2:

Date: _____ Project Manager: _____ EHSC: _____
Brief description of amendment:
_____
_____

4. SITE/TASK DESCRIPTION

The following is a brief description of the Site, including information as to the location, approximate size, previous usage, and current usage. A description of the tasks to be performed is also presented.

- Site Location: 92 County Line Road, Colmar, Pennsylvania
- Approximate Size of Site: ~11 acres
- Previous Site Usage: Manufactured parts utilized in automobile hatch-backs, gates, and trunks (gas pistons, shock absorbers, etc.)
- Current Site Usage: Manufacture packaging materials for pharmaceutical, confectionary, beverage, cosmetic, snack food, and other industries.
- Description of Surrounding Property/Population:

North	Agricultural/Commercial	East	Agricultural/Residential
South	Commercial/Residential	West	Wooded/Residential/Commercial

- Summary of previous Site investigations (if available/applicable):

Specific to the Operable Unit 2 (OU2) overburden, elevated levels of volatile organic compounds (VOCs) were detected in the overburden on the former Stabilus property (currently operated by Constantia Colmar) and the former BAE property (currently operated by Sensor Systems) as presented in the Supplemental II RI/FS (USEPA, 2003). The 2003 USEPA investigation identified two areas of observed elevated levels of trichloroethene (TCE) with one near the loading dock of the former Stabilus property and the other located within the former BAE property.

The origins of the TCE near the former Stabilus property loading dock is presumed to be from a spill caused by Baron Blakeslee, Inc., later Honeywell.

Based upon the public record for NP5 and as noted in the USEPA prepared documents including the Responsiveness Summary issued by USEPA, within the

Interim ROD in September 2011 (USEPA, 2011), USEPA has not identified a specific source for the elevated levels of TCE in the overburden on the former BAE property. Overburden investigation is expected to provide additional data about the nature and extent of groundwater contamination at OU2, including possible sources.

- Task Descriptions:

Task 1: Site Walk and Siting of Intrusive Investigation Locations

Prior to starting intrusive field activities, Geosyntec will field locate the investigation locations for the OU2 overburden groundwater investigation (Task 4), and the completion of the performance monitoring well network installation activities (Task 5). Locations of intrusive investigation will be field located via a handheld Global Positioning System (GPS) device. Additionally, locations of existing monitoring wells within OU2 will be field located.

Task 2: Oversight of On-site Utility Clearance

Piror to completion of intrusive field activites, the Pennsylvania one-call (811) will be used to Site utilities entering the property. For intrustive locations not within the area of the Pennsylvania one call system, the area will be screened for utilities by a geophysical subcontractor. Geosyntec will oversight the geophysical subcontractor for the on-site utility clearance.

Task 3: Oversight of Clearing and Grubbing (if necessary)

As necessary, Geosyntec will oversee a subcontractor for clearing and grubbing of wooded or overgrown areas that may be necessary in order to perform intrusive activities, or gain access to existing monitoring wells within OU2.

Task 4: Overburden Groundwater Investigation

Geosyntec will coordinate and oversee a drilling subcontractor to perform direct-push drilling for installation of soil borings, collection of groundwater samples, and installation of temporoary monitoring wells.

Soil samples will be collected from select locations in the overburden in order to understand the nature and current level of the contamination sources within the subsurface, and the soil characteristics. Soil samples will be collected for both laboratory analytical testing and for use in the EISB treatability study.

Groundwater samples will be collected via direct push in situ groundwater sampling methods via HydroPunch™ or similar method. For locations completed as a soil boring, groundwater samples will be collected from temporary wells. The groundwater samples will be collected in order to delineate the nature and extent of contamination and

contaminant sources in overburden groundwater. These samples will be necessary to define the overburden treatment zone and remediation approach. Groundwater samples will be collected for both laboratory analytical testing and for use in the EISB treatability study.

Upon completion of Task 4 and Task 6, Geosyntec will oversee the abandonment of the temporary well points by a PA licensed driller.

Results of the soil and groundwater sampling will be used to design the EISB remedy and the performance monitoring well network.

Task 5: Performance Monitoring Well Network Installation

Geosyntec will oversee a drilling subcontractor to perform the installation of overburden and shallow bedrock monitoring wells via air-rotary drilling techniques. Monitoring well construction will be based on results of the groundwater delineation (Task 4). Redevelopment of select exisiting overburden and bedrock monitoring wells may be completed as well as part of this task.

For the shallow bedrock wells, the tasks anticipated include oversight of downhole geophysical and packer well testing as well as collection of groundwater samples.

Task 6: Oversight of Surveying Activities

Geosyntec will oversee a land surveying subcontractor to survey in the vertical and horizontal position following the completion of the overburden groundwater and soil sampling locations (Task 4) and will include the existing monitoring well locations within OU2. Geosyntec will again oversee the land surveying subcontractor following the completion of the performance monitoring well network locations (Task 5).

5. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Table 1 lists project personnel and their responsibilities in regard to health and safety concerns on this project.

6. WORKER TRAINING

Table 2 presents the training and medical monitoring that project personnel have received in accordance with the company Environmental, Health, and Safety (EH&S) Training Program. Pre-entry briefings and daily tailgate meetings shall also be conducted to facilitate Site-specific training.

7. MAPS AND SITE CONTROL

7.1 Routes to Hospital and Urgent Care Facility

A hospital and an urgent care facility near the Site have been identified. Figure 1A presents the route to the hospital, for emergency care. Figure 1B presents the route to an urgent care facility, for non-emergency care. Both figures also include the facility name, phone number, and written directions from the Site. The figures are included at the front of this HASP.

7.2 Site Map

A Site map is presented on Figure 2, located inside the cover of this HASP. The Site map is intended to show the location of the work zone(s), to provide on-site orientation, and to delineate evacuation routes. Changes may be made to the Site map by the SHSO based on changing Site conditions. The Site map should be accessible in the work area.

7.3 Buddy System

The buddy system is required for all tasks. The buddy system includes maintaining regular contact with onSite Geosyntec personnel, clients, and/or contractors to periodically check on the condition of Site workers. In situations when only one employee is performing field work, on-site personnel must have appropriate communication devices on his/her persons at all times and shall maintain contact with off-site personnel. The field worker must communicate with off-site personnel, at a minimum, of three times daily: (1) upon arriving at the Site; (2) midway through the work day; and (3) upon departing from Site.

7.4 Controlled Work Zones

APPLIES TO TASK: ☐① ☐② ☐③ ☒④ ☒⑤ ☐⑥ ☐⑦ ☐⑧ ☐ Not Applicable

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. The Exclusion Zone is defined as the area on Site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as Site investigation information becomes available. For Sites that do not require the three controlled work zones, the area(s) where work is to be performed shall be called the Work Zone.

The boundaries of the Exclusion Zone, CRZ, and Support Zone or the Work Zone shall be marked using the following methods:

☐ Warning tape
☐ Signs
☒ Other: Caution Tape
☒ Traffic cones
☒ Fence (as needed on former BAE parcel)

7.5 Site Access

Access to the Site must be controlled using the following method:

☒ Sign in/Sign out log
☐ Identification badges
☐ Other: _____
☐ Guard
☐ Check in with SHSO

7.6 Visitors

Visitors to the Site may need to be continually escorted for safety purposes. Geosyntec employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have received the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HASP. Other visitors under Geosyntec's direction (subcontractors, etc.) may review this HASP for Site familiarity, but they are ultimately responsible for their own health and safety (see disclaimer in Section 1).

7.7 Safe Work Practices

General Safe Work Practices that must be implemented during work activities at this Site are listed in Table 3.

7.8 Inspections

For projects with field components lasting longer than one week, the SHSO must conduct periodic health and safety inspections. The inspections must be documented using the Health & Safety Inspection Checklist, presented in Appendix B. The Health & Safety Inspection Checklist records should be kept on file at the project Site.

The requirement for periodic inspections is:

☐ Not Applicable
☒ Applicable, and the frequency shall be:

☐ Weekly
☐ Bi-Weekly
☒ Monthly

8. HAZARD ANALYSIS AND MITIGATORS

Site specific hazards have been identified through a hazard analysis. Hazard analysis included a review of chemical, physical, and biological hazards. The analysis also identified health and safety hazard mitigators needed to protect workers, which are presented in Appendix C.

8.1 Chemical Hazards

Potential exposure pathways to chemical health hazard agents include inhalation, dermal exposure, and/or ingestion. To effectively manage risk to exposure, constituents of concern (COCs) have been identified. Potential exposure to these COCs will be mitigated through engineering, administrative, and/or PPE controls. The COCs are documented and/or suspected materials present based on previous operations/activities. The identified COCs for this project are listed in Appendix D with appropriate hazard information, including signs of exposure. Hazard Mitigators, which include control measures and methods to minimize exposure, are presented in Appendix C. Also, airborne levels of COCs may be estimated or measured to evaluate levels of PPE that will be required for individual tasks. The type(s) of air monitoring to be performed are discussed in Section 9.

8.2 Physical Hazards

Physical hazards due to the tasks to be performed (e.g., electrocution due to drilling, etc.) and due to the Site setting and condition (e.g., slips, trips, or falls due to rocky terrain, etc.) were analyzed. Hazard mitigators for each physical hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

8.3 Biological Hazards

Biological hazards (e.g., allergic reactions to poisonous plants or insects indigenous to the area, etc.) associated with tasks to be performed were analyzed. Hazard mitigators for each biological hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

9. AIR MONITORING

APPLIES TO TASK: ☐① ☐② ☐③ ☒④ ☒⑤ ☐⑥ ☐⑦ ☐⑧ ☐ Not Applicable

Air monitoring will be performed to evaluate airborne exposure levels associated with the COCs on Site within the breathing zone of Site workers. Hazardous conditions may include concentrations that may cause acute or chronic illness, potential oxygen deficient environments, or potential explosive environments. Air monitoring may also be performed to evaluate the adequacy of engineering, administrative, and/or PPE controls. Air monitoring may be "real-time" (e.g., the instrument provides immediate results at the project), using multi-gas meters, photoionization detectors (PIDs), or colorimetric tubes. "Non-real-time" monitoring may also be performed by collecting samples and forwarding to a laboratory for analysis and quantification.

The type(s) of air monitoring equipment required to evaluate COCs is outlined in Appendix E. Monitoring equipment must be calibrated based on the manufacturer's requirements. Calibration results and air monitoring measurements must be documented. Based on the results noted and Site activities or scope of work changes, the frequency of air monitoring may be adjusted on Site by the SHSO with the consent of the Project Manager and communication with the EHSC.

10. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in Appendix F. Required equipment and types of protective clothing materials, as well as an indication of the initial level of protection to be utilized, are listed. The level of protection may be upgraded or downgraded by the SHSO according to mitigation measures required in Appendix C or according to action guidelines provided in Appendix E. The PPE levels that are implemented must be documented in a daily field log.

If respirators are worn, workers must abide by the company's Respiratory Protection Program in accordance with 29 CFR §1910.134. Table 2 provides a record of the last fit test for each Site worker that may be required to wear a respirator. Fit tests are valid for a period of one year. Persons with facial hair that may interfere with the respirator seal may not wear respirators.

11. DECONTAMINATION

The SHSO and Project Manager will determine the type and level of decontamination procedures for both personnel and equipment based on evaluation of specific work activities in the controlled work zones. In an emergency, the primary concern is to

prevent the loss of life or serious injury to personnel. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving "hot zones" where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of closure and disposal of coveralls, disposable boots, and gloves, (if applicable).

Decontamination of personnel in Level C, if applicable, will consist, at a minimum, of:

- Removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- Removal, cleaning, and storage of respiratory protection;
- Washing of boots or other non-disposable PPE (e.g., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using a soap solution followed by a water rinse; and
- Removal and disposal of inner gloves.

Wash solutions and PPE may require disposal at a licensed waste facility. Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions, or, if possible, by dry decontamination.

12. EMERGENCY PREPAREDNESS AND RESPONSE

A table presenting a list of contacts and telephone numbers for the applicable local off-site emergency responders is provided inside the front cover of this HASP (after figures). If the nature of the Site work and COCs requires that off-site responders be notified before work begins on this project, the date that the pre-notification was made is presented in the table.

The following emergency response equipment is required for this project:

☒ First Aid Kit
☒ Fire Extinguisher (Type ABC)
☒ Eyewash bottle
☐ Other: _____

In the event of an injury to an employee, the Instructions for Injury Response, located in the front of this HASP, must be implemented immediately. 'Tear-out' forms are located after the Instructions for Injury Response. If professional medical attention is required, these forms must be provided to the medical provider at the time the medical attention is administered. Injury reporting is required per the procedures presented on the Instructions for Incident Reporting, also located in the front of this HASP.

In the event that an emergency develops, the procedures delineated in the Emergency Response Procedures, located in the front of this HASP, are to be followed immediately. (Note that an emergency does not necessarily include an injury.) After the emergency is resolved, post-incident reporting is required per the procedures presented on the Instructions for Incident Reporting, also located in the front of this HASP.

13. CONFINED SPACE ENTRY

☐ APPLICABLE ☒ NOT APPLICABLE

The task(s) for this project involve confined-space entry. Workers must abide by the company's Confined Space Entry Program [29 CFR §1910.120(j)].

14. SPILL CONTAINMENT

☒ APPLICABLE ☐ NOT APPLICABLE

The task(s) for this project involve handling of drums and/or containers that contain stored chemicals and/or wastes associated with sampling, excavation, transportation, etc. Workers must implement the hazard mitigating procedures for drum/container handling presented in Appendix C.

15. CHEMICAL HAZARD COMMUNICATION LABELING

☒ APPLICABLE ☐ NOT APPLICABLE

The following procedures must be followed for chemicals brought onto the Site by Geosyntec personnel (i.e., decontamination solution, sampling preservatives, KB-1 solution, sodium permanganate, etc.) while performing the tasks of this project:

- Labels on primary chemical containers must not be defaced.
- Chemical containers must be stored in appropriate storage containers.

- Secondary containers and storage cabinets must be correctly and clearly labeled using the Hazardous Materials Identification System (HMIS).
- Chemicals incompatible with each other must not be stored together.
- Workers must receive training on the chemical hazards.
- Material Safety Data Sheets (MSDSs) for the chemical must be added to Appendix G.

When chemicals are used on Site, workers must abide by Geosyntec's Hazard Communication Program.

Table 1

Key Personnel and Health & Safety Responsibilities

Principal-in-Charge or Associate-in-Charge Chris Voci	***Project Manager (PM)*** Derek Tomlinson	***Site Health & Safety Officer (SHSO)*** Michelle Mirigliano	***Project Personnel***	***Environmental, Health & Safety Coordinator (EHSC)*** Scott Douglas
• Approve this HASP and amendments, if any. • Verify that elements of this HASP are implemented.	• Approve this HASP and amendments, if any. • Monitor the field logbooks for health and safety work practices employed. • Coordinate with SHSO so that emergency response procedures are implemented. • Verify that corrective actions are implemented. • Verify and document that personnel receive this plan and are aware of its provisions and potential hazards associated with Site operations, and that they are instructed in safe work practices and familiar with emergency response procedures. • Provide for appropriate monitoring, personal protective equipment, and decontamination materials.	• Prepare and implement project HASP and amendments, if any, and report to the Project Manager for action if any deviations from the anticipated conditions exist and authorize the cessation of work if necessary. • Verify that Site personnel meet the training and medical requirements. • Conduct pre-entry briefing and daily tailgate safety meetings. • Verify that all monitoring equipment and personal protective equipment is operating correctly according to manufacturer's instructions and such equipment is utilized by on-site personnel. Calibrate or verify calibration of all monitoring equipment and record results. • Verify that decontamination procedures are being implemented. • Implement Site emergency response and follow-up procedures. • Notify the EHSC in the event an emergency occurs. • Perform weekly inspections.	• Provide verification of required health and safety training and medical surveillance prior to arriving at the Site. • Notify the SHSO of any special medical conditions (e.g., allergies). • Attend pre-entry briefings and daily tailgate safety meetings. • Immediately report any accidents and/or unsafe conditions to the SHSO. • Be familiar with and abide by the HASP. • Be ultimately responsible for his or her own safety.	• Review and audit HASP and amendments. • Maintain a copy of the cover sheet of each completed HASP. • Notify Director of Environment, Health & Safety in the event an emergency occurs. • Assist with the implementation of the corporate health and safety program. • Consult on health and safety issues.

TABLE 2

Training / Medical Surveillance / Respirator Fit Test Records

	Employee name	Category	Initial 40 Hour	Initial 24 Hour	Annual 8 Hour Refresher	8 Hour Supervisor	CPR	First Aid	Medical Surveillance	Annual Respirator Fit Test	Other
	MIRIGLIANO,		5/20/2000		12/31/2011		4/6/2011	4/6/2011	6/6/2012		
	ROWAN, AMY		2/10/2012		5/2/2012		7/26/2012	7/26/2012	1/31/2012		
	TOMLINSON, DEREK		11/6/1998		5/2/2012	10/24/2000			4/11/2011		
	VOCI, CHRISTOPHER		8/6/1992		5/2/2012		3/11/2011	2/17/2010	1/30/2009		

Footnotes:

1 CPR Refresher: every year; First Aid Refresher: every three years.

2 Annual Medical Surveillance for EH&S Category I, Biannual Medical Surveillance for EH&S Categories II & III.

3 For EH&S Categories I & II Only.

Table 3

General Safe Work Practices

- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially contaminated surfaces.
- Smoking, eating, or drinking after entering the work zone and before decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the Site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C or B personal protective equipment is required.
- Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.
- Use of contact lenses may not be allowed under certain hazardous working conditions.
- The following conditions must be observed when operating a motor vehicle.
  - Wearing of seat belts is mandatory
  - The use of headlights is mandatory during periods of rain, fog, or other adverse weather conditions
  - A backup warning system or use of vehicle horn is mandatory when the vehicle is engaged in a backward motion
  - All posted traffic signs and directions from flagmen must be observed
  - Equipment and/or samples transported in vehicles must be secured from movement
  - The use of vehicles acquired by Geosyntec by non-Geosyntec personnel is prohibited
- In an unknown situation, always assume the worst reasonable conditions
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve any motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol must not be allowed. Workers unwilling or unable to comply with the established procedures must be discharged.

Appendix A

HASP Amendments

Discuss details of amendments to this HASP here. Include amendment number, date, and details of amendments.

Appendix B

Health & Safety Inspection Checklist

Project: _____ Date: _____

Inspected by: _____

Category	*Observations/Corrective Actions (N/A, if Not Applicable)*
Pre-entry briefing records are current	
Tailgate meeting records are current	
Training/medical surveillance/respiratory protection records are current	
Site map is posted	
Buddy system is implemented	
Work zones are identified	
Site access is controlled	
Visitors are being escorted	
On-site/off-site communications are in working order	
Safe work practices are being implemented	
Any additional hazards incurred?	
Air monitoring equipment is in working condition	
Air monitoring records are being recorded in field logbook	
Air monitoring calibration records are being recorded in field logbook	
PPE storage area is neat and organized	
Standard operating procedures are being implemented	
Housekeeping at decontamination zone is appropriate	
Decontamination procedures are being implemented	
Emergency response equipment is in working condition	
Route to hospital is posted	
Confined space entry program is being implemented	
Spill containment equipment is available	
Chemical inventory is up to date	
Material safety data sheets are available	
Primary and secondary containers are properly labeled	
Housekeeping at the chemical storage area is appropriate	

Appendix C

Hazard Analysis and Hazard Mitigators

TASKS	
① Site Walk / Siting of Intrusive Investigation Locations	⑤ Performance Monitoring Well Network Installation
② Oversight of On-site Utility Clearance	⑥ Oversight of Surveying Activities
③ Oversight of Clearing and Grubbing (if necessary)	⑦
④ Overburden Groundwater Investigation	⑧

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
I. Chemical Hazards								
Fire			X	X	X			
Permanganate Handling								
Reactivity								
Skin absorption				X	X			
II. Physical Hazards								
Bioaugmentation Culture Handling								
Boating								
Chainsaw			X					
Cold Stress	X	X	X	X	X	X		
Compressed Gas Cylinder				X	X			
Downhole Logging					X			
Drilling (including Indoor)				X	X			
Drum and Container Handling				X	X			
Electrocution								
Excavation/Trenching								
Eye Injury			X	X	X			
Fall Protection								
Flash Flood								
Hand/Foot Injury	X	X	X	X	X	X		
Heat Stress	X	X	X	X	X	X		
Heavy Equipment			X	X	X			

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
Helicopter								
Knives / Blades			X	X	X			
Lifting Heavy Loads			X	X	X			
Lockout/Tagout								
Loud Noise			X	X	X			
Nuclear Gauge Radiation Exposure								
Portable Power/Hand Tool			X	X	X			
Slips, Trips, and Falls	X	X	X	X	X	X		
Thoroughfares	X	X	X	X	X	X		
Truck Crane								
Urban Environments								
Utility Protection			X	X	X			
Welding and Cutting				X	X			
Other:								
III. Biological Hazards								
Allergic Reaction to Poisonous Plants	X	X	X	X	X	X		
Alligators								
Dogs								
Stinging Insects / Vermin / Snakes	X	X	X	X	X	X		
Medical Waste								
Mountain Lions								
Other:								

An X in a box indicates that the listed hazard is applicable to the respective task. The appropriate Hazard Mitigators are presented in this Appendix.

FIRE

- Know fire prevention procedures, fire-fighting techniques and essential precautions to prevent injury.
- Do not stop to get anything out of a building or area if evacuation is required. JUST GET OUT - and assemble in the predetermined evacuation assembly points.
- There are 3 elements to starting a fire: a fuel source, an oxygen source and a point of ignition.
- Know how and when to use different types of fire extinguishers.
- Keep all fire extinguishers in workable condition and accessible at all times. Access to or visibility of extinguishers shall not be obstructed.
- Control static electricity (e.g., ground equipment)
- Remove only the minimum required supply of paints, solvents, or other flammables from storage. At no time shall the quantity removed exceed one day's working supply.
- Do not allow combustible products of rubbish, waste or other residues to accumulate. Oil soaked rags and material subject to spontaneous combustion shall only be stored in non-combustible containers with self-closing lids.
- Do not store gasoline, flammable solvents, and liquids inside a building unless the structure has been approved for flammable storage containers. Only OSHA-approved storage cabinets shall be used for all flammable liquids, paints or solvents.
- Flammable liquids shall be stored in locations that will not interfere with evacuation of the area in case of a fire.
- Do not permit smoking, striking of matches, or other sources of ignition outside of designated "SMOKING" areas.
- Discard cigarette butts, matches or other similar materials in non-combustible containers.

SKIN ABSORPTION

- Be aware of chemicals of concern that can directly injure (corrode, burn, dehydrate) the skin or that can be absorbed into the bloodstream and subsequently transported to other organs from dust, liquid or vapor sources.
- Know that skin absorption is enhanced by abrasions, cuts, heat, and moisture.
- Do not wear contact lenses in contaminated atmospheres (since they may trap chemicals against the eye surface). The eye is particularly vulnerable because airborne chemicals can dissolve in its moist surface and be carried to the rest of the body through the bloodstream (capillaries are very close to the surface of the eye).
- Keep hands away from face.
- Minimize contact with liquid and solid chemicals.
- Wear protective clothing (e.g., suits and gloves) as specified by the Site Specific Health and Safety Plan.

COLD STRESS

- Work in pairs to keep an eye on each other and watch for signs of cold stress.
- Wear layers of loose fitting clothing, including insulated coveralls, head covering, gloves and boots.
- Minimize wind chill effects by wearing a wind resistant outer shell.
- Minimize lengthy periods of outdoor activity. This may require additional shifts and taking frequent breaks to warm up.
- Provide warm shelter.
- Remain hydrated. There is a tendency not to drink as many fluids when temperature is cold.
- Be aware of the symptoms of cold stress and appropriate first aid measures. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0°F or if the wind chill factor drops below -29°F.

Signs and symptoms:

Mild hypothermia

Shivering, lack of coordination, stumbling, fumbling hands, slurred speech, memory loss, pale and cold skin.

Moderate hypothermia

Shivering stops, unable to walk or stand, confused and irrational.

Severe hypothermia

Severe muscle stiffness, very sleepy or unconscious, ice cold skin.

Treatment:

Mild hypothermia

Move to warm area, stay active, remove wet clothes and replace with dry clothes or blankets, cover the head, drink warm (not hot) sugary drink.

Moderate hypothermia

Call for an ambulance, cover all extremities completely, Place very warm objects, such as hot packs or water bottles on the victim's head, neck, chest and groin and follow treatments for mild hypothermia.

Severe hypothermia

Call for an ambulance, treat the victim very gently, cover all extremities completely.

COMPRESSED GAS CYLINDER

- Keep cylinder valve caps screwed on at all times when regulators and gauges are not attached to the cylinder and when the cylinder is being moved.
- Do not use force to remove valve cap if stuck.
- Protect cylinders from cuts and abrasions.
- Use extreme care not to drop cylinders.
- Secure cylinders in an upright position using chains or other approved restraints.
- Do not use cylinders for rollers or support.
- Do not tamper with cylinder valves or safety devices.
- Do not lift cylinders using the protective valve caps.
- Do not substitute oxygen for compressed air.
- Store all oxygen cylinders at least 20 feet from all fuel gas cylinders and gasoline or diesel storage tanks.
- Keep cylinders away from exposure to open flame.
- Do not use oil or grease on oxygen cylinders or regulator connections to avoid an explosion.
- All cylinders must be labeled and indicate when they have been emptied.
- Check all valves and fittings on a cylinder for leaks with each use. If leakage is found, place a tag on the cylinder indicting the defect, and report it to the SHSO.
- Leak test all connections using soap solution where possible.
- Be certain that the second stage of the regulator is closed, after attaching the regulator to the cylinder, but before opening the cylinder valve.
- Stand to one side of the regulator gauge while you slowly open the cylinder valve 1/4 of a turn.
- Keep wrench on the valve stem of an acetylene cylinder when in use.
- Close the cylinder valve and bleed the pressure off hoses on cylinders when not in use.
- Use a cylinder cart to transport cylinders distances greater than 2 feet.

DOWNHOLE LOGGING

- All members of the drilling crew shall be trained in the safety features and procedures to be utilized during operation, inspection, and maintenance of the equipment.
- Set up equipment on stable ground. Cribbing (a system of timbers, arranged in a rectangular pattern, used to support and distribute the weight of the equipment) shall be used when necessary.
- Potentially unsafe shafts SHALL NOT be entered.
- A cage with a solid plate on top shall always be used when downhole logging. Wear hard hats, steel-toed boots, and eye protection at all times in case of falling debris.
- Be sure equipment (including the cage and lights) are in good working condition and the hoist line is free of rust/wear before lowering the downhole logger.
- The boring is a confined space. The Geosyntec Confined Space Entry Program must be followed strictly.
- Prior to entry into a shaft, air monitoring shall be conducted to ensure that the shaft does not contain dangerous air contamination or an oxygen deficiency. This monitoring shall continue for the duration of the logging.
- Be sure the air line is operational before beginning downhole logging work (if required). If supplied air is used it must be certified for breathing use purposes.
- The downhole logger shall wear a full safety harness at all times when performing logging activities and shall be tethered directly to the hoist line, separate from the cage.
- A 12-inch to 18-inch diameter steel cone-shaped headguard/deflector will be attached to the hoist cable above the harness.
- Workers will be in continuous verbal contact with the downhole logger to provide surveillance of his/her conditions while logging is carried out. Any sign of changes in verbal communication of the logger, he/she will immediately be lifted to the surface.
- All wells, shafts, caissons, etc shall be barricaded or securely covered when not in use.
- Surface personnel should keep back from the mouth of the boring to prevent rocks and other debris from falling into the hole.
- Monitor weather conditions. Operations shall cease during electrical storms or when electrical storms are imminent.

DRILLING (Including Indoor)

- All members of the drilling crews shall be trained in the standard operating safety features and procedures to be utilized during operation, inspection, and maintenance of the equipment.
- Wear hard hats, steel toed boots, hearing protection and safety glasses at all times when performing drilling operations.
- Conduct a survey, prior to bringing drilling equipment to the job Site, to identify overhead electrical hazards, potential subsurface hazards, and terrain hazard. Once on Site, before drilling equipment is moved, the travel route shall again be visually surveyed for overhead and terrain hazards. Document possible hazards and communicate them to the drilling crew.
- Use only drilling equipment equipped with two easily-accessible emergency shutdown devices, one for the operator and one for the helper. Shutdown devices should be tested at the beginning of each day.
- Do not transport drilling equipment with the mast in the upward position.
- Extend outriggers per the manufacturer's specifications.
- Monitor weather conditions. Operations shall cease during electrical storms or when electrical storms are imminent.
- Wearing of loose clothing (e.g., open shirts, hooded sweatshirts, etc) is not permitted.
- When appropriate use auger guides on hard surfaces.
- Verbally alert employees and visually ensure employees are clear from dangerous parts of equipment prior to starting or engaging equipment.
- Channel the discharge of drilling fluids away from the work area to prevent the ponding of water.
- Use hoists only for their designed intent. Hoists shall not be loaded beyond their rated capacity. Steps shall be taken to prevent two-blocking of hoists (the condition when the lower load block or hook assembly comes in contact with the upper load block, or when the load block comes in contact with the boom tip). Follow the equipment manufacturer's procedures if ropes become caught in, or objects are pulled into a cathead.
- Do not run or rotate drill rods through rod slipping devices. No more than 5 feet of drill rod column shall be hoisted above the top of the drill mast. Drill rod tool joints shall not be made up, tightened, or loosened while the rod column is supported by a rod slipping device.
- Control dust using dust suppression techniques.
- Clean augers, drill casing, or drill rod only when the rotating mechanism is in neutral and the pipe is stationary is stopped.

- Cap and flag open boreholes; open excavations shall be barricaded.
- Keep all hand tools used during drilling operations clean and in good working condition.
- Check fire extinguishers and notify all onSite personnel to their whereabouts.
- Check cables for frays and hydraulic hoses for leaks daily.
- In situations where ambient water level may be above top of well screen, during well construction, ensure that well casing is vented to prevent air pressure build-up in blank casing above screen.

Indoor Drilling

- Conduct a survey, prior to bringing drilling equipment to the job Site, to identify ceiling height, overhead hazards, potential subsurface hazards, terrain hazard, and building stability particularly during drilling activities. Identify sources of ventilation (including open doorways for cross ventilation and fans to assist in air flow). Once on Site, before drilling equipment is moved, the travel route shall again be visually surveyed for overhead and terrain hazards and avenues of ventilation will be opened or turned on.
- Notify and/or evacuate all building occupants prior to start of drilling activities.
- All drilling rig exhaust will be redirected outdoors by tubing. The perimeter of the outdoor exhaust area shall be roped off a suitable distance to allow proper ventilation of exhaust.
- Monitor ambient oxygen percentage and carbon monoxide concentrations in the work zone, as well as entire indoor area, to prevent low oxygen or high carbon monoxide environments. Operations shall cease and the building will be evacuated if levels become dangerous.

DRUM AND CONTAINER HANDLING

- Only trained personnel should open drums containing unknown materials.
- Bulging drums or containers are an indication of pressure build-up. Open all drums or bungs extremely slowly to determine the presence of vapors or pressure inside the drum. If the possibility of fire or explosion exists, a protective shield should be used and/or remote opening devices. Employees not directly involved with opening a container shall be kept a safe distance away.
- Use only drums and containers that meet the appropriate DOT, OSHA, and EPA regulations.
- Utilize drum/container handling equipment whenever possible. The equipment should have a sufficiently rated load capacity and should be able to operate smoothly on the available surface.
- Label and identify drums and containers when moved to the staging areas to safely identify and classify their contents. Segregate incompatible drums.
- Inspect the integrity of the drum container before moving. Any drum or container lacking integrity shall be placed within an over pack container.
- Staging areas require adequate escape routes. Staging area should provide secondary containment for all moved drums.
- Employees must be warned of the potential hazards associated with the contents of containers or drums prior to moving said containers or drums.
- Organize Site operation to minimize the amount of drum or container movement. Have a clear view of the available pathway when moving drums. If needed, an additional person should be available to provide guidance.
- Never stand on drums or containers.
- Use non-sparking tools and appropriate grounding and bonding equipment.
- Appropriate fire extinguishing equipment must be onSite at all times during drum handling.
- Spill control equipment shall be onSite in areas where spills ruptures or leaks may occur.

EYE INJURY

- Wear appropriate eye protection according to the task at hand.

HAZARD	TYPE OF PROTECTION
Impact	Safety glasses with side shield or vented safety goggles
Heat (Sparks)	Vented safety goggles or safety glasses with a face shield
Chemical	Hooded vented safety goggles or full-face respirator (if mild chemicals then safety glasses with side shield is acceptable)
Light Radiation	Tinted/reflective safety glasses or tinted/reflective face shield
Dust	Hooded vented safety goggles

- Apply anti-fog product to lens not previously treated.
- Minimize the amount of vapor or particulate matter generated, if possible.
- Avoid touching the face and eyes.
- Flush eyes with water for at least 15 minutes if chemicals do get into the eyes. If condition persists, seek medical attention.
- If dust or foreign objects are in your eyes, do not rub your eyes.
- If an object becomes embedded in the eye, do not attempt to remove. Lightly bandage your eyes, or both eyes, if possible and immediately seek medical attention.
- Do not wear contact lenses if chemical or dust hazard is present (e.g. decontamination or preservation chemicals used during sampling).
- Provide on-site training to workers before tasks at hand.
- If visitors enter area, stop work until they are properly protected.

HAND/FOOT INJURY

- Wear protective gloves as required in the Health and Safety Plan. Gloves should be chosen to suit the work being performed (e.g., chemical resistant gloves will be worn when handling chemicals or sampling for suspected chemicals).
- Steel-toed/steel-shanked safety boots must be worn whenever working around heavy objects (or as required by the HASP). Insulated and/or waterproof boots may also be warranted depending on weather conditions. Boots should be inspected periodically for signs of wear (e.g., cracks in rubber or along soles) and replaced as required.
- Durable footwear which provides adequate ankle support should be worn when working in rugged terrain.
- Use proper lifting techniques to avoid dropping heavy loads on hands and feet (refer to lifting heavy loads hazard mitigator)
- Be aware of moving machinery and heavy equipment in the work area and tuck away any loose clothing.

HEAT STRESS

Prevention:

- Drink plenty of hydrating fluids, such as Gatorade® or water. In high heat, a minimum of one gallon per day should be consumed. Fluid should be consumed frequently. Don't wait until thirsty.
- Provide cooling devices, when necessary, to aid natural body heat exchange during prolonged work or severe heat exposure. Devices include field showers, hose-down areas, shade umbrellas/tents, wide-brim hats, and cooling jackets, vests, or suits.
- If amenable to work conditions, wear light-colored, loose fitting, "breathable" clothing.
- Avoid prolonged periods of exposure. Take breaks as necessary. Higher heat exposure requires more frequent breaks.
- Be able to recognize the signs, symptoms and how to treat for heat stress. Signs, symptoms and treatment are listed below.

Signs and Symptoms:

- Mild heat stress - Decreased energy, slight loss of appetite, nausea, lightheadedness.
- Moderate heat stress - heavy sweating, thirst, faintness, headache, confusion.
- Severe heat stress (heat stroke) - Throbbing headache, confusion, irritability, rapid heartbeat, difficulty breathing, dry skin (no sweating), vomiting, diarrhea.

Treatment:

- Mild and Moderate heat stress - Take to cool place, drink cool (not cold) fluids, remove excess clothing, rest.
- Severe heat stress - Call 911 for an ambulance and get to a cool place, remove excess clothing and rest.
- Adjust work and rest schedules as needed. Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers.
- Provide shelter or shaded areas (77ºF is best) to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must equal the approximate amount of water lost in sweat. Workers are encouraged to drink more than the amount required to satisfy thirst (recommend water and sport drinks, not coffee or soda), because thirst is not an adequate indicator of adequate salt and fluid replacement.
- Remove impermeable protective garments during rest periods.
- Do not assign other tasks to personnel during rest periods.

HEAVY EQUIPMENT

Working around Heavy Equipment

- Yield to heavy equipment.
- Listen for warning signals on heavy equipment.
- Perform a visual inspection and walk around parked heavy equipment before moving to assure that equipment is in good condition and that there are no personnel on the ground that could be injured or objects that could be damaged by vehicle movement.
- Wear hearing protection if required.
- Wear traffic vests for increased visibility.
- Maintain eye contact with the heavy equipment operator when working near equipment.
- Be aware of changes in sound of equipment which may indicate a change in direction.

Heavy Equipment Operators

- Use hand rails and footholds when mounting and dismounting equipment,
- Brakes, steering, clutches and controls shall be tested.
- Pay attention to workers on the ground who may be in the path and provide warning prior to moving the equipment.
- Permit no one to ride on, or in, heavy equipment. This includes any portion of a backhoe, bulldozer, forklift or the back of a pickup truck, except in locations specifically designed for passenger use and approved by the SHSO.
- Keep haulage vehicles under positive control at all times while operating. Vehicles shall be kept in gear when descending grades.
- Do not use heavy equipment on slopes with steepness exceeding 3H:1V unless operations are consistent with manufacturer's recommendations (if the Owner's Manual is not with the equipment or does not specify slope operating procedures, see the SHSO).
- Operate equipment with booms, blades, buckets, beds, etc., lowered or in a stable position while on slopes. Safety cables tethered to appropriate anchors shall be used for equipment working on steep slopes, where appropriate.
- Suspend in slings or support by hoists or jacks heavy equipment in need of repair. The equipment must also be blocked or cribbed before working underneath.
- Shut off motors, do not allow smoking, and use proper dispensing equipment when refueling gasoline-operated equipment to prevent fire hazards.
- Lower hydraulic systems (e.g., blades, etc.) to the ground, set brakes, and shut down equipment if malfunction occurs.
- Use rollover protection and seat belts.

KNIVES / BLADES

- Always wear proper protective equipment. This should include:

  - heavy-duty leather gloves,

  - steel-toed boots with non-slip soles, and

  - hardhat and eye protection.

- Check the work area and make sure that:

  - the ground is free of obstacles such as rocks, stumps, holes, and wet or otherwise slippery conditions.

  - you can get a firm footing on the ground.

- Route cords, hoses, and cables supplying power to portable power tools to prevent tripping hazards.
- Protect tools from corrosion damage.
- Keep tools free of accumulated dirt and unnecessary oil or grease.
- Worn, damaged or dull blades should be sharpened or replaced as necessary.

LIFTING HEAVY LOADS

- Proper lifting techniques include:
  - *Feet* - Feet should be parted, with one foot alongside the object being lifted and one behind. Feet should be comfortably spread to give greater stability. The rear foot should be in position for the upward thrust of the lift.
  - *Back* - Use the sit-down position and keep the back straight, but remember that "straight" does not mean "vertical". A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the abdomen that can cause a hernia.
  - *Arms and Elbows* - The load should be drawn close to the body, and the arms and elbows should be tucked in. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps keep body weight centered.
  - *Palm* - The palm grip is one of the most important elements of lifting. The fingers and the hand are extended around the object to be lifted. Use the full palm; fingers alone have very little power.
  - *Chin* - Tuck in the chin so the neck and head continue the straight back line. Keep the spine straight and firm.
  - *Body Weight* - Position the body so its weight is centered over the feet. This provides a more powerful line of thrust and assures better balance. Start the lift with a thrust of the rear foot. Shift hand positions so the object can be boosted after knees are bent. Straighten knees as object is lifted or shifted to the shoulders. To change direction, lift the object to a carrying position, and turn the entire body, including the feet. Do not twist your body. In repetitive work, both the person and the material should be positioned so that the worker will not have to twist his body when moving the material. If the object is too heavy to be handled by one person, get help.

- Limit continuous lifting of weights to 50 pounds or the maximum allowed by the client whichever is less. Lifts of heavier weights are permitted on an interim basis. Help shall be obtained for lifting of loads greater than 50 pounds or the maximum allowed by the client whichever is less. Mechanical equipment should be used on heavy materials when possible. If mechanical assistance is not available, adequate manpower to maintain the 50-pound limit per employee will be required.
- Do not lift more weight than can be handled comfortably, regardless of load weight. If necessary, help should be requested to lift a load so that the lifting is comfortable.
- Use drum dollies when moving drums or barrels.

- Inspect objects for grease or slippery substances before they are lifted to ensure that the object will not slip.
- Do not carry long, bulky or heavy objects without first verifying that the way is clear and that vision is unobstructed. This ensures that other persons or objects will not be struck by the load.
- Do not carry loads that cannot be seen over or around.
- Exercise caution when lifting above the chest level.
- Make sure workers are physically suited for the job before assigning jobs requiring heavy and/or frequent lifting. A person's lifting ability is not necessarily indicated by his height or weight.
- Before lifting an object, consideration should be given to how the object will be set down without pinching or crushing hands or fingers. For example, to place an object on a bench or table, the object should be set on the edge and pushed far enough onto the support so it will not fall. The object can then be released gradually as it is set down, and pushed in place with the hands and body from in front of the object.
- When two or more people are handling the same object, one should "call the signals". All the persons on the lift should know who this person is and should warn him if anyone in the crew is about to relax his grip.

LOUD NOISE

- Wear hearing protection in areas with constant or loud noise.
- Know the effects of noise, including:
  - Workers being startled, annoyed, or distracted.
  - Physical damage to the ear, pain, and temporary and/or permanent hearing loss.
  - Communication interference that may increase potential hazards due to the inability to warn of danger and proper safety precautions to be taken.
- Implement the company Hearing Conservation Program when noise exposures equal or exceed an 8-hour, time-weighted average (TWA) sound level of 85 decibels on the A-weighed scale (dB).
- Utilize feasible administrative or engineering controls if workers are subjected to noise exceeding an 8-hour TWA sound level of 90 dB.

SLIPS, TRIPS, AND FALLS

- Wear the proper foot wear and clothing for the task at hand.
- Pay attention to the work environment and become aware of all equipment and vehicles active onSite and use caution when moving about.
- Use caution when walking on sloped areas (especially geosynthetics), particularly when moisture is present. Use caution when walking on soft or uneven surfaces; e.g., marsh areas. Watch for icy conditions in cold weather.
- Follow the established designated safe paths for travel and keep these areas free from debris. Avoid steep or slippery slopes and paths near operation vehicles and equipment.
- Follow good housekeeping procedures. Never assume that someone else will clean up a spill or put away an object.
- Remove or clearly mark objects that pose tripping hazards.
- Prevent water accumulation where practicable.
- Cables and/or wiring should be taped down, when possible. Locate cables and/or wiring out of the commonly used areas.
- Mark or repair any opening or hole in the floor.
- Carry objects in a manner that allows you to see in the area you are moving in. Do not carry objects that are too large or bulky. Do not carry more weight than you can balance and keep stable. Understand that PPE can reduce or limit your field of vision and mobility.
- Use the proper ladder for the task at hand and do not exceed the recommended height. Do not use the top two rungs of a ladder. Ensure a flat and stable footing for the placement of a ladder. Utilize the buddy system to help secure the ladder. When working over 6 ft., utilize fall prevention measures. Obey height and weight guidelines and/or rules.
- Use the handrail when using stairs. Be aware of stairway blockages.
- If conditions even slightly resemble an unsafe environment, do not make any assumptions that the integrity of a workplace is intact.
- Never jump over or into a trench or excavation.
- Walk, do not run.
- Maintain proper lighting so obstacles are clearly visible

THOROUGHFARES

- Obtain necessary permits to use/block public thoroughfares.
- All care should be taken to ensure the integrity of walking and working surfaces, including the use of barriers, toe-kicks, etc. to warn personnel and the public of the potential fall and tripping hazards. Guardrails or barrier walls should be constructed surrounding open pits and trenches as appropriate.
- Traffic control plans will be produced and followed when required by the permitting agency or when working on or adjacent to a highway or a busy street. The traffic control plan shall be brought to the Site and shall delineate the locations of applicable signs, signals and barricades; describe the necessity for flaggers; and provide other traffic control information..
- Signaling equipment and directions by flaggers shall conform to the latest edition of the U.S. Department of Transportation – Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways (http://mutcd.fhwa.dot.gov).
- Flaggers shall be provided with and shall wear fluorescent orange-red or fluorescent yellow-green garments while flagging. Warning garments worn at night shall be made of reflective material. The garments should meet the requirements of ISEA, American National Standard for High-Visibility Apparel.
- Barricades for protection of employees shall conform to the portions of the latest edition of the U.S. Department of Transportation – Federal Highway Administration,, Manual on Uniform Traffic Control Devices for Street and Highways (http://mutcd.fhwa.dot.gov), relating to barricades.

UTILITY PROTECTION

The occurrence of above and below-ground utilities should be anticipated at every Site. The traditional method of using existing "as built" plans and maps (if available) and probing in the field (i.e., "hunt and hope") is not sufficient to provide adequate assurance that utilities are not impacted during Site activities. Geosyntec developed this Utility Protection Hazard Mitigator to implement prior to conducting intrusive Site activities (i.e., drilling, well installation, trenching, excavation, hand auguring, etc.). The objective of the Utility Protection Hazard Mitigator is to describe the process necessary to investigate, and to the extent practical, identify utilities in work areas for the purpose of avoiding the utilities, protecting utilities and Site personnel, and mitigating impacts to Site operations.

Approximate location of subsurface installation means a strip of land not more than 24-inches on either side of the exterior surface of the subsurface installation.

Excavation means any operation in which earth, rock, or other material in the ground is moved, removed, or otherwise displaced by means of tools, equipment, or explosives in any of the following ways: grading, trenching, digging, ditching, drilling, auguring, tunneling, scraping, cable or pipe plowing and driving, or any other way.

High priority subsurface installation means high-pressure natural gas pipelines with normal operating pressures greater than 415 kPa gauge (60 psig) or greater than six inches nominal pipe diameter, petroleum pipelines, pressurized sewage pipelines, high-voltage electric supply lines, conductors, or cables that have a potential to ground of greater than or equal to 60 kilovolt (kV), or hazardous materials pipelines that are potentially hazardous to workers or the public if damaged.

The Mitigator process is summarized below:

- Identify the location of the planned intrusive activities.
- Mark the planned work area with white water based marking paint. If work area is not visible from the street either because of obstruction or distance, provide distance from street to work area (i.e., 150 feet north).
- Contact DigAlert or dial 811 (nationwide) to identify utilities in your work area. http://www.digalert.org/ (811) provides a link to the local state operated "Call-Before-You-Dig" service.
- Review existing utility maps with facility personnel and determine the approximate numbers and types of utilities within the project area. This is inclusive of below-ground utilities that may be encountered during intrusive operations as well as overhead utilities that may be encountered during operations (i.e., drilling mast and overhead power lines).
- Most "Call-Before-You-Dig" services will only mark below-ground utilities leading to the Site utility meter. With the exception of high priority utilities (as defined above), utilities present after passing through the Site meter may be left without adequate inspection. In such cases, the use of a private utility location firm may be prudent to ensure thorough identification of utilities.
- Retain the services of a private utility locating company that can identify metallic utilities and anomalies in the vicinity of the work area. Private utility location firms use a variety of location techniques. The suspected types of utilities should be discussed

with the private utility location firm to ensure that proper techniques are used. Improper techniques may result in missed or improperly identified utilities.

- DigAlert must be called at least 48 hours prior to the start of work to complete a utility inspection. (For example, if you notify DigAlert on Tuesday at 9:43 a.m. no work can begin until Thursday at 9:43 a.m.)
- Record the inspection confirmation number. Confirm that the inspection was conducted prior to the start of work. The inspection confirmation number is critical in the event that an unmarked utility is encountered, or if a utility identified during the inspection request did not mark the Site for the presence or absence of the utility (no-show). If a no-show occurs with it may be possible that the utility operator sent a facsimile care of the project manager (identified during utility inspection request) indicating that there are no conflicts in the planned work area. However, if there is any question, contact DigAlert immediately and request that the missing utility please call to confirm presence or absence of utility in work area or schedule a meeting time at the Site.
- After below-ground utilities are identified, the utilities should be marked. The most common marking method is paint or pin flags. The following marking colors are generally widely accepted to demarcate specific types of utilities, but should be confirmed.

RED	ELECTRIC
YELLOW	GAS, OIL, STEAM
ORANGE	COMMUNICATIONS
BLUE	POTABLE WATER
PURPLE	RECLAIMED WATER
GREEN	SEWER / DRAINAGE
PINK	SURVEY MARKS
WHITE	PROPOSED EXCAVATION

- Above-ground utilities should be visually identified. Warning signs may be placed in work areas to remind workers of the above-ground utilities. Other techniques such as shielding or utility relocation may be necessary to make the work safe. Proper set back and approach distances must be maintained at all times.
- Be observant of above-ground features at a Site that may be indicative of an underground utility line. An example of this would be noticing two fire hydrants and noting that there is likely a buried water line between them, sings of trenching activities, asphalt or concrete patches, or linear depressions in the ground surface.
- Following the completion of the utility marking, the work area should be inspected by all members of the project team (client, engineer, and contractor) to inspect and discuss the finding. Adjustments to Site operations, if necessary, should be discussed and agreed

upon by the project team prior to initiation of Site work. If possible, work areas should be re-located away from utilities.

- If conditions allow, consider using vacuum excavation.
- Depending on the proximity of utilities to the work area, low impact soil removal techniques (potholing) may be necessary to either confirm the presence of utilities or to provide protection of utilities before invasive activities. In such cases, hand excavation, hand auguring, vacuum excavation, water jet removal, or other low impact removal techniques may be necessary to a depth of 3 to 5 feet (or other depth as determined by project-specific conditions). In cases where a high priority utility is located within 10 feet of the work area, documentation from the utility owner must be obtained allowing potholing before any work can be conducted. If the utility is not found after potholing is conducted, contact DigAlert and the utility owner immediately to request additional information as to the location of the utility. It is necessary to conduct potholing activities before any work can be conducted in the vicinity (within 10 feet) of the high priority utility.
- If utility location markings are lost, damaged, or faded, a new utility location survey should be conducted to replace the missing or damaged markings. Please note that some municipalities require that all utility markings be removed after work is completed. Black spray paint may be used to cover up utility markings in the street but must be removed from sidewalks.
- In all cases, State, local, utility-specific requirements, facility-specific controls, permits, and operations should be considered and incorporated into the Utility Protection Hazard Mitigator.
- Utility protection should be addressed during each tailgate or job briefing in order to reinforce below-ground utility location and the avoidance of above-ground utilities.

ALLERGIC REACTION TO POISONOUS PLANTS

- Be able to recognize and identify poisonous plants indigenous to the Site location (e.g., poison ivy, poison oak, poison sumac). For example, poison Ivy plants have three leaves arranged at the end of each stem. Two secondary leaves are attached oppoSite one another and directly to the stem at their base. The primary leaf is attached to the end of the stem. The leaves often, but NOT ALWAYS, have a shiny appearance. See photos below.



- Poison Ivy often appears as ground cover at the edge of wooded areas and along trails within fields and woods. It may also appear growing from a vine wrapped around trees.
- Avoid or remove poisonous plants where practicable. Wear appropriate protective clothing (e.g., gloves, long-sleeved shirts) as required.
- One can become sensitized (like a latex allergy) though immune for several years at the beginning.
- If you come in contact with the plant, the plant's oil will be transferred onto your skin and clothing. The best way to manage the oil is to wash skin with cool water and soap (preferably 5% tincture of green soap available at CVS). If soap and water is unavailable, thorough (2-3 minutes) rinsing with cold water may help (not warm...want to keep those pores closed!)
- The lag time between exposure and symptoms can be quite long like several days.
- If you are in the field, blot the area with an alcohol patch and follow by washing as soon as possible. Calamine lotion, Tecnu, yellow laundry soap, or Colloidal oatmeal (Aveeno®) baths provide relief from itching and rashes. More information about Tecnu can be found at http://www.teclabsinc.com/.
- If you have to pass through heavy ivy growth, be sure to carefully handle your field cloths when you return. Your shoe laces will always get you if you are not careful. The oil can last on clothing for a few weeks, so wash frequently.
- For additional information, please see http://poisonivy.aesir.com/

STINGING INSECTS / VERMIN / SNAKES

- Be able to recognize stinging insects/vermin/snakes indigenous to the Site location and habitats. Learn the indigenous dangerous species (e.g., spiders, snakes, ticks) prior to entering the field and know the first aid treatments.
- Venomous snakes swim on top of the water, non-venomous snakes swim with only their heads above water.
- Advise the SHSO if you have allergies to any insects prior to engaging in any field activities.
- Include the following preventative measures as necessary: wear light-colored clothing, keep clothing buttoned, tuck pant legs into socks, keep shirt tails tucked in, boots, hoods, netting, gloves, masks, insect repellants or other personal protection.
- Snake bite kits are commercially available and should be carried by field personnel when working where venomous snakes exist. In the case of a snake bite, keep the patient calm, restrict activity and immobilize the bite area (do not elevate), and immediately obtain medical attention.
- Report any bites or stings to the SHSO and seek medical attention immediately.
- Be aware of potential hive/nest locations, which may include culverts, drainage pipes, junk piles, or dense shrubbery.
- Advise the SHSO if you are allergic to stinging insects prior to engaging in any field activities.
- Include the following controls:
  - Do not agitate stinging insects or disrupt their hive/nest.
  - Wear light-colored clothes.
  - Avoid wearing perfumes, hair spray, or scented lotions in the wilderness.
- If attacked:
  - <u>Do not</u> scream or wave arms.
  - Cover your face with your hands.
  - Run for shelter in a building or vehicle. Do not seek shelter in water.
  - Remove stingers as quickly as possible to lessen the amount of venom entering the body. Remove the stinger by raking your fingernail across it. Don't pinch or pull the stinger out. Put ice on the sting to reduce the swelling.

Report any stings to the SHSO and seek first aid or emergency medical care immediately if stung several times.

Appendix D

Constituents of Concern (COCs)

Constituent[1]	*Medium*[2]	*Maximum Concentration*[3]
Trichloroethene (TCE)	GW Soils	7,600 µg/L 0.120 mg/kg
Tetrachloroethene (PCE)	GW Soils	254 µg/L 0.042 mg/kg
cis-1,2-Dichloroethene (DCE)	GW Soils	2,150 µg/L 0.0034 mg/kg
Vinyl Chloride (VC)	GW Soils	220 µg/L 0.042 mg/kg

Footnotes:

1 Constituents that are included on this list have either been detected at the Site at concentrations that may cause potential dermal, ingestion, or inhalation hazards, or the constituent is suspected to potentially be present at elevated concentrations but no analytical data are available.

2 Type of medium (i.e. soil, water, sludge, etc.).

3 Maximum concentration previously detected for the constituent based on historic data (if available). Liquid concentrations are presented in micrograms of constituent per liter of solution (ug/L). Solids concentrations are presented in milligrams of constituent per kilogram of soil (mg/kg). Soil gas and/or vapor concentrations are reported in milligrams of constituent per cubic meter of gas/vapor (mg/m^3).

Trichloroethylene

Synonyms & Trade Names

Ethylene trichloride, TCE, Trichloroethene, Trilene

CAS No.	RTECS No.	DOT ID & Guide
79-01-6	KX4550000	1710 160

Formula	Conversion	IDLH
$ClCH=CCl_2$	1 ppm = 5.37 mg/m^3	Ca [1000 ppm] See: 79016

Exposure Limits

NIOSH REL

: Ca See Appendix A See Appendix C

OSHA PEL

†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)

Measurement Methods

NIOSH 1022, 3800;
OSHA 1001
See: NMAM or OSHA Methods

Physical Description

Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW:	BP:	FRZ:	Sol:	VP:	IP:
131.4	189°F	-99°F	0.1%	58 mmHg	9.45 eV

Sp.Gr:	Fl.P:	UEL(77°F): 10.5%	LEL(77°F): 8%		
1.46	?				

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities

Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Exposure Routes

inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms

irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs

Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site

[in animals: liver & kidney cancer]

Personal Protection/Sanitation

(See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid

(See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection
See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236

Tetrachloroethylene

Synonyms & Trade Names

Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

CAS No.	RTECS No.	DOT ID & Guide
127-18-4	KX3850000	1897 160
Formula	**Conversion**	**IDLH**
$Cl_2C=CCl_2$	1 ppm = 6.78 mg/m^3	Ca [150 ppm] See: 127184

Exposure Limits

NIOSH REL

: Ca Minimize workplace exposure concentrations. See Appendix A

OSHA PEL

†: TWA 100 ppm
C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm

Measurement Methods

NIOSH 1003; **OSHA** 1001
See: NMAM or OSHA Methods

Physical Description

Colorless liquid with a mild, chloroform-like odor.

MW:	BP:	FRZ:	Sol:	VP:	IP:
165.8	250°F	-2°F	0.02%	14 mmHg	9.32 eV
Sp.Gr:	**Fl.P:**	**UEL:**	**LEL:**		
1.62	NA	NA	NA		

Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Incompatibilities & Reactivities

Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Exposure Routes

inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms

irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]

Target Organs

Eyes, skin, respiratory system, liver, kidneys, central nervous system

Cancer Site

[in animals: liver tumors]

Personal Protection/Sanitation	First Aid
(See protection codes) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	(See procedures) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection
See also: INTRODUCTION See ICSC CARD: 0076 See MEDICAL TESTS: 0179

1,2-Dichloroethylene

Synonyms & Trade Names

Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene

CAS No.	RTECS No.	DOT ID & Guide
540-59-0	KV9360000	1150 130P
Formula	**Conversion**	**IDLH**
ClCH=CHCl	1 ppm = 3.97 mg/m^3	1000 ppm See: 540590

Exposure Limits

NIOSH REL

: TWA 200 ppm (790 mg/m^3)

OSHA PEL

: TWA 200 ppm (790 mg/m^3)

Measurement Methods

NIOSH 1003; **OSHA** 7
See: NMAM or OSHA Methods

Physical Description

Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.

MW:	BP:	FRZ:	Sol:	VP:	IP:
97.0	118-140°F	-57 to -115°F	0.4%	180-265 mmHg	9.65 eV
Sp.Gr(77°F): 1.27	Fl.P:	UEL:	LEL:		
	36-39°F	12.8%	5.6%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities

Strong oxidizers, strong alkalis, potassium hydroxide, copper [Note: Usually contains inhibitors to prevent polymerization.]

Exposure Routes

inhalation, ingestion, skin and/or eye contact

Symptoms

irritation eyes, respiratory system; central nervous system depression

Target Organs

Eyes, respiratory system, central nervous system

Personal Protection/Sanitation	First Aid
(See protection codes) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet (flammable) **Change:** No recommendation	(See procedures) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH/OSHA

Up to 1000 ppm:
(APF = 25) Any supplied-air respirator operated in a continuous-flow mode[£]
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)[£]
(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
(APF = 50) Any self-contained breathing apparatus with a full facepiece
(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0436

Vinyl chloride

Synonyms & Trade Names

Chloroethene, Chloroethylene, Ethylene monochloride, Monochloroethene, Monochloroethylene, VC, Vinyl chloride monomer (VCM)

CAS No.	RTECS No.	DOT ID & Guide
75-01-4	KU9625000	1086 116P (inhibited)
Formula	**Conversion**	**IDLH**
CH_2=CHCl	1 ppm = 2.56 mg/m^3	Ca [N.D.] See: IDLH INDEX

Exposure Limits

NIOSH REL

: Ca See Appendix A

OSHA PEL

: [1910.1017] TWA 1 ppm C 5 ppm [15-minute]

Measurement Methods

NIOSH 1007; **OSHA** 4, 75
See: NMAM or OSHA Methods

Physical Description

Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. [Note: Shipped as a liquefied compressed gas.]

MW:	BP:	FRZ:	Sol(77°F): 0.1%	VP:	IP:
62.5	7°F	-256°F		3.3 atm	9.99 eV
	Fl.P:	UEL:	LEL:	RGasD:	
	NA (Gas)	33.0%	3.6%	2.21	

Flammable Gas

Incompatibilities & Reactivities

Copper, oxidizers, aluminum, peroxides, iron, steel [Note: Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol. Attacks iron & steel in presence of moisture.]

Exposure Routes

inhalation, skin and/or eye contact (liquid)

Symptoms

lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]

Target Organs

Liver, central nervous system, blood, respiratory system, lymphatic system

Cancer Site

[liver cancer]

Personal Protection/Sanitation	First Aid
(See protection codes) **Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** No recommendation **Remove:** When wet (flammable) **Change:** No recommendation **Provide:** Frostbite wash	(See procedures) **Eye:** Frostbite **Skin:** Frostbite **Breathing:** Respiratory support

Respirator Recommendations

(See Appendix E)

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0082 See MEDICAL TESTS: 0241

Geosyntec consultants

Appendix E

Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task

Applies to Task: ☐ ① ☐ ② ☐ ③ ☒ ④ ☒ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☐ *Explosimeter*

Brand/Model No.: _____

Monitoring Frequency: ____

Source Reading (% LEL)	Action
1 to 10	Continue with caution.
Greater than 10	Stop work. Evacuate the area. If upon return, if concentration still exceeds 10% LEL, ventilate until concentration is back to <10% LEL.

Note: _____

☐ *Oxygen Meter*

Brand/Model No.: _____

Monitoring Frequency: ____

Reading (%)	Action
Less than 19.5	No action.Stop work. Evacuate the area.
19.5 to 23.5	Continue to work with caution.
Greater than 23.5	Stop work. Evacuate the area.

Note: _____

☒ *Photoionization Detector*

Brand/Model No.: RAE Systems MiniRAE 3000

Monitoring Frequency: Continuous

Breathing Zone Reading (ppm)	Action
0 to 10	Level D PPE
>10 to 100	Level C PPE
Greater than 100	Stop work. Evacuate the area. If upon return, levels still exceed 100, Stop work and implement engineering controls.

Note: _____

☐ *Flame Ionization Detector*

Brand/Model No.: _____

Monitoring Frequency: ____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

☐ *Chemical Detector Tube*

Brand/Model No.: _____

Monitoring Frequency: ____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

☐ *Other*

Brand/Model No.: _____

Monitoring Frequency: ____

Breathing Zone Reading	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls.

Note: _____

Appendix F

Personal Protective Equipment per Task

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☐ D ☐ C	☐ D ☐ C

Modified Level D*		***Level C****	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☐ Protective clothing		☐ Full-face air-purifying respirator	Cartridge Type:
☐ Outer gloves		☐ Half-mask air-purifying respirator	Cartridge Type:
☐ Outer boots		☐ Protective clothing	
☒ Hard hat**		☐ Outer gloves	
☒ Safety glasses**		☐ Inner gloves	
☒ Hard-toed boots**		☐ Outer boots	
☒ Hearing protection**		☐ Hard hat**	
☐ Other:		☐ Safety glasses**	
		☐ Hard-toed boots**	
		☐ Hearing protection**	
		☐ Other:	

* If checked, indicates initial level of PPE. Other completed columns indicate information to upgrade/downgrade.

** Optional as applicable

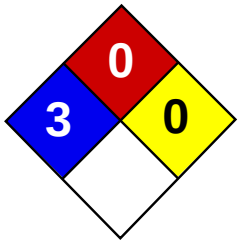
Appendix G

Material Safety Data Sheets

Included in HASP	*Chemical*
☐	Acetone
☒	Alconox
☐	Ammonia
☒	Bentonite
☐	Diesel Fuel Oil No. 2-D
☐	Gasoline
☐	Helium
☐	*n*-Hexane
☒	Hydrochloric Acid
☐	Hydrogen
☒	Isobutylene Calibration Gas
☐	Isopropyl Alcohol
☐	KB-1
☐	Methane Calibration Gas
☒	Nitric Acid
☐	Permanganate
☒	Portland Cement
☐	Sulfuric Acid
☒	Other: Methanol

Geosyntec
consultants

MSDSs



Material Safety Data Sheet
Nitric Acid, 10% w/w MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric Acid, 10% w/w

Catalog Codes: SLN1330

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Nitric acid, 70%; Water

CI#: Not applicable.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	93
Nitric acid, fuming	7697-37-2	7

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 67 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Non-sensitizer for skin. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist

may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive to explosive in presence of reducing materials, of combustible materials, of organic materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as reducing agents, combustible materials, metals, alkalis. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package. Corrosive materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Nitric acid, fuming TWA: 2 CEIL: 4 (ppm) TWA: 5 CEIL: 10 (mg/m3) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 82.6°C (180.7°F) (Nitric acid, fuming). Weighted average: 98.78°C (209.8°F)

Melting Point: May start to solidify at -41.6°C (-42.9°F) based on data for: Nitric acid, fuming.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.02 (Water = 1)

Vapor Pressure:
The highest known value is 45 mm of Hg (@ 20°C) (Nitric acid, fuming). Weighted average: 19.46 mm of Hg (@ 20°C)

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: The highest known value is 0.29 ppm (Nitric acid, fuming)

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Extremely reactive or incompatible with alkalis. Highly reactive with metals. Reactive with reducing agents, combustible materials. Slightly reactive to reactive with organic materials, acids.

Corrosivity:
Highly corrosive in presence of steel, of aluminum, of zinc, of copper. Corrosive in presence of stainless steel(304). Slightly corrosive to corrosive in presence of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute toxicity of the vapor (LC50): 957 ppm 4 hour(s) (Rat) (Calculated value for the mixture).

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 8: Corrosive liquid.

Identification: : Nitric acid, solution (Nitric acid, fuming) : NA2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Nitric acid, 70% Massachusetts RTK: Nitric acid, 70% TSCA 8(b) inventory: Nitric acid, 70%; Water SARA 302/304/311/312 extremely hazardous substances: Nitric acid, 70% SARA 313 toxic chemical notification and release reporting: Nitric acid, 70% CERCLA: Hazardous substances.: Nitric acid, 70%;

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R26- Very toxic by inhalation. R35- Causes severe burns.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 11:00 AM

Last Updated: 06/09/2012 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

MATERIAL SAFETY DATA SHEET

BENTONITE PELLETS

1. PRODUCT IDENTIFICATION

TRADE NAME: **BENTONITE PELLETS**
Use: Natural Mineral Montmorillonite drilling fluid additive
Description: Natural Sodium Bentonite

Supplier Name: Fluidstar (Pty) Ltd
Address: Unit 3/No. 1 General McArthur Place Redbank Qld 4301
Telephone: + 61(0) 7 3288 4480, email: info@fluidstar.com.au
Emergency Contact: +61 400 195 406

2. HAZARDS IDENTIFICATION

NON-HAZARDOUS ACCORDING TO CRITERIA OF AUSTRALIAN NATIONAL OCCUPATIONAL HEALTH & SAFETY COMMISSION (NOHSC), AUSTRALIA.
NOT CLASSIFIED AS DANGEROUS GOODS, ACCORDING TO THE AUSTRALIAN CODE FOR THE TRANSPORT OF DANGEROUS GOODS BY ROAD AND RAIL.

RISK PHRASES:
Not applicable
SAFETY PHRASES:
S22 Do not breathe dust.
S38 If insufficient ventilation, wear suitable respiratory equipment.
CAUTION:
Avoid inhalation. Avoid contact with eyes. Do not take internally.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	CAS #	Concentration
Smectite	12199-37-0	>74%
Quartz/Cristobalite	14808-60-7& 14464-46-1	<18%
Plagioclase	Mixture	<8%
Feldspar/Kaolinite		

4. FIRST AID INFORMATION

FIRST AID
EYES:
Flush the eyes immediately with large amounts of water, lifting the upper and lower lids occasionally. If irritation persists or for imbedded foreign body, get immediate medical attention.
SKIN:
No first aid should be needed since this product does not affect the skin. Wash exposed skin with soap and water before breaks and at the end of the shift.
INGESTION:
Do not induce vomiting. Wash mouth with water. If symptoms persist, get immediate medical attention.
INHALATION:
Remove source of contamination or move victim to fresh air. If breathing has stopped, perform artificial respiration. If breathing is difficult have qualified personnel administer oxygen. Get prompt medical attention.
NOTE TO PHYSICIAN:
Based on the individual reactions of the patient, the physician's judgment should be used to control symptoms and clinical condition.
CAUTION:
If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

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5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA:
This product is not considered flammable, nor will it support combustion. However the packaging may burn under fire conditions. Use extinguishing media appropriate to the surrounding fire. Do not use water jets.

COMBUSTION PRODUCTS:
Smoke, fumes and dust may be generated in a large fire.

FLAMMABLE LIMITS:
Not Applicable **LEL** - Not Applicable **UEL** - Not Applicable

UNUSUAL FIRE AND EXPLOSION HAZARD:
None known

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6. ACCIDENTAL RELEASE MEASURES

SPILL CONTROL AND RECOVERY:
Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water; product will become slippery when wet.
Waste Disposal Method – Follow federal, state and local regulations for solid waste.

DISPOSAL:
If this product becomes a waste, it does not meet the criteria of a hazardous waste.

---

7. HANDLING AND STORAGE

HANDLING:
Prevent the creation of dust concentration higher than the occupational exposure limit. Wear appropriate protective equipment to prevent inhalation, skin and eye contact. Keep containers closed when not in use. Ensure a high level of personal hygiene is maintained when using the product.

STORAGE:
Store in a dry area. Keep container tightly sealed.

---

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

NATIONAL EXPOSURE STANDARDS:
No exposure standards have been established for this material by the Australian National Occupational Health & Safety Commission (NOHSC). However, the available exposure limits on ingredients are as follows:
Quartz- TWA 0.1 mg/m^3
Cristobolite-TWA 0.1 mg/m^3
In addition, NOHSC has set the following exposure standard for dust not otherwise specified:
Dust-TWA 10 mg/m^3 (inspirable fraction).
TWA (Time Weighted Average): The average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day week.

RESPIRATORY PROTECTION:
If engineering controls are not effective in controlling airborne exposure then an approved respirator with a replaceable particulate filter should be used. Reference should be made to Australian Standards AS/NZS 1715, Selection, Use and Maintenance of Respiratory Protective Devices; and AS/NZS 1716, Respiratory Protective Devices, in order to make any necessary changes for individual circumstances.

Eye Protection
Safety glasses with side shields or chemical goggles should be worn. Final choice of appropriate ye/face protection will vary according to individual circumstances. Eye protection devices should conform with Australian/New Zealand Standard AS/NZS 1337 - Eye Protectors for Industrial Applications.

Hand Protection
Wear gloves of impervious material conforming to AS/NZS 2161: Occupational protective gloves - Selection, use and maintenance. Final choice of appropriate glove type will vary according to individual circumstances. This can include methods of handling, and engineering controls as determined by appropriate risk assessments.

Body Protection
Suitable protective workwear should be worn when working with this material, e.g. cotton overalls buttoned at neck and wrist.

Engineering Controls
Good ventilation adequate to maintain the concentration below exposure standards is required.

HYGIENE MEASURES:
Ensure a high level of personal hygiene is maintained when using this product. Always wash hands before eating, drinking, smoking or using the toilet facilities.

---

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR:	Tan or beige to light gray colored tablets, odourless
BOILING POINT:	Not Applicable
SPECIFIC GRAVITY:	(Water = 1.0) - 2.38
pH VALUE:	7-10 (20% aqueous slurry)
FLASH POINT:	Non-combustible solid
SOLUBIITY IN WATER:	Insoluble. Forms colloidal suspensions in water, with strong thixotropic properties.

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10. STABILITY AND REACTIVITY

STABILITY:
Stable

CONDITIONS TO AVOID:
None Known

INCOMPATIBILITY:
(*Materials to Avoid*)**:** None Known

Hazardous Decomposition or By-products:
None Known

HAZARDOUS POLYMERIATION:
Will Not Occur

11. TOXICOLOGY INFORMATION

Ecotoxicity	Not available

12. ECOLOGICAL INFORMATION

MOBILITY:
Not available

PERSISTENCE /DEGRADABILITY:
Not available

BIOACCUMULATION:
Not available

ECOTOXICITY:
Not available

13. DISPOSAL REGULATIONS

SPILL CONTROL AND RECOVERY:
Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water; product will become slippery when wet. Waste Disposal Method – Follow federal, state and local regulations for solid waste.

DISPOSAL:
If this product becomes a waste, it does not meet the criteria of a hazardous waste.

14. TRANSPORT INFORMATION

THE PRODUCT IS NOT CLASSIFIED AS DANGEROUS GOODS, ACCORDING TO THE AUSTRALIAN CODE FOR THE TRANSPORT OF DANGEROUS GOODS BY ROAD AND RAIL.

UN NUMBER:	None allocated
SHIPPING NAME:	None allocated
DANGEROUS GOODS CLASS:	None allocated
HAZCHEM CODE:	None allocated
SUBSIDIARY RISK:	None allocated
PACKAGING GROUP:	None allocated
EPG NUMBER:	None allocated

15. REGULATORY INFORMATION

POISONS SCHEDULE:
None allocated

AICS:
All chemicals listed on the Australian Inventory of Chemical Substances.

HAZARD CATEGORY:
Toxic

---

16. OTHER INFORMATION

Date of Preparation: Issue Date 20-Oct-05
Last Revision: Revised 14 Apr 2009

CONTACT POINTS

ORGANISATION	TELEPHONE
Poisons Information Centre –Australia Wide	131126
Fluidstar	+61 7 3288 8485
	0400 195 406
Fire Brigade	000
Police	000

Disclaimer:

Every endeavor has been made to ensure that the information contained in this publication is reliable and offered in good faith. It is meant to describe the safety requirements of our products and should not be construed as guaranteeing specific properties. Customers are encouraged to conduct their own tests as end user suitability of the product for particular uses is beyond our control. The information is not intended as an inducement to bargain and no warranty expressed or implied is made as to its accuracy, reliability or completeness. FLUIDSTAR Pty Ltd accepts no liability for loss, injury or damage arising from reliance upon the information contained in this data sheet except in conjunction with the proper use of the product to which it refers. Due care should be taken that the use and disposal of this product is in compliance with appropriate Federal, State and Local Government regulations.

END OF MSDS

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**
CHEMICAL FAMILY NAME:	Detergent.
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER:	Not Applicable
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada** 800-255-3924
	International calls 813-248-0585
BUSINESS PHONE:	914-948-4040
DATE OF PREPARATION:	May 2011
DATE OF LAST REVISION:	February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

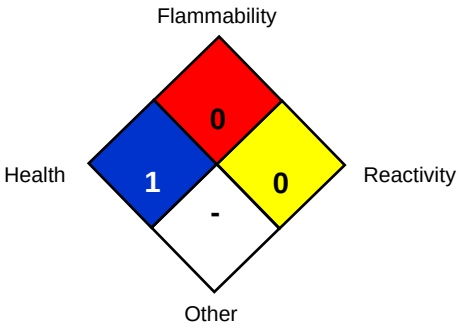
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	1
FLAMMABILITY HAZARD (RED)	0
PHYSICAL HAZARD (YELLOW)	0

PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: **0** = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.
SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

MATERIAL SAFETY DATA SHEET
(HYDROCHLORIC ACID)

I. PRODUCT IDENTIFICATION

Chemical Name : Hydrochloric Acid
Trade Name : Technical Grade Muriatic Acid
Synonyms : Muriatic Acid, Spirit of Salts

II. COMPOSITION / INGREDIENTS

Hydrochloric Acid, % : 32 – 34 % by weight
Chemical Formula : HCl
Molecular Weight : 36.46 g/mole
CAS Registry No. : 7647-01-0

III. HAZARDS IDENTIFICATION

THIS PRODUCT MAY BE : corrosive, toxic and a major potential hazard upon contact to skin, eyes and respiratory tract.

TOXICITY ROUTES OF EXPOSURE :

Ingestion can cause severe burns of the mucous membranes of the mouth, esophagus and stomach; pain, nausea and vomiting may also occur.

Inhalation causes irritation of the upper respiratory tract resulting in cough, burning of the throat and choking sensation.

Skin contact to a high concentration of the HCl gas or liquid may cause burns; repeated or prolonged exposures to dilute solutions may cause dermatitis.

Eye exposure to high concentration of the acid can cause eye irritation to severe destruction like prolonged or permanent visual impairment, including blindness. These effects occur rapidly affecting all parts of the eye. Mist can also cause irritation to destructive burns.

OVEREXPOSURE :

Can cause serious damage to all body tissues contacted.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Fumes may aggravate eye, skin or respiratory conditions. Effects are usually limited to inflammation and occasionally ulceration of the nose, throat and larynx, if inhaled deeply, pulmonary edema may occur.

IV. FIRST AID MEASURES

SKIN : Remove contaminated clothing and immediately wash skin for a minimum of 15 minutes. Call or see a physician.

EYES : Immediately flush eyes with large amount of water. Occasionally lifting the upper and lower eyelids and rotating the eyeballs. Continue flushing for a minimum of 15 minutes. Call a physician.

INHALATION : Remove to fresh air. If breathing stops, administer artificial respiration. Call a physician.

INGESTION : DO NOT induce vomiting. Rinse or wash mouth with water. If person is conscious, give 2 or more glasses of water. If unconscious, never give anything **by mouth. See a physician immediately.**

V. FIRE FIGHTING MEASURES

Autoignition Point : Not Applicable
Flash Point : Not Applicable
Flammability/Explosive limits : Not Applicable
Fire/Explosion Hazards: Emits toxic and choking fumes of hydrogen chloride. Hydrochloric acid is not flammable but flammable and explosive hydrogen gas may be formed on contact with metals.
Fire Prevention/ Extinguishing Media : Not Applicable

VI. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR RELEASE ;

Move people from the area. Move upwind. Avoid contact with acid. Stop leaks if safe to do so. Reposition container if this will reduce or stop leakage. If leak continues, remove leaking container from vehicle or move other materials from vehicle away from container. Absorb spill with sand or earth. If available, cover the spill with excess soda ash, lime or sodium bicarbonate, otherwise, wash away with large amounts of water. Scoop slurry to plastic drums. If leak cannot be safely stopped or if contents cannot be safely transferred to a sound container, contact fire brigade.

VII. HANDLING AND STORAGE

Storage Requirements: Keep container tightly closed.
FOR SMALL VOLUMES : Maybe stored in plastic jugs, carboys, and plastic drums.
FOR LARGE VOLUMES : Store in rubber-lined or epoxy lined steel storage tanks or fiber glass reinforced polyester (FRP) tanks.
Incompatible Materials: Store away from heat
Use Instructions: Wear suitable protective clothing, gloves and eye/face protection. In case of insufficient ventilation, wear suitable respiratory equipment.

VIII. EXPOSURE CONTROLS AND PROTECTION

Ventilation: Use only in well-ventilated areas.
Protective Equipment for the eyes and skin :
Splash proof and face shield goggles, disposable latex/ rubber apron, PVC rain suit, rubber boots with pant legs over boots.
Respiratory Protection Requirements: NIOSH/MSHA approved respirator should be used.
Precautionary Hygiene/control measures :
Avoid contact with skin, eyes, and clothing. Do not breathe mist or vapor. Wash thoroughly after handling. Safety showers and eye wash fountains should be available in storage and handling area. Any protective clothing contaminated with hydrochloric acid should be removed immediately and thoroughly laundered before wearing again.

IX. PHYSICAL AND CHEMICAL PROPERTIES

STATE	:	fuming liquid
APPEARANCE	:	colorless to slightly yellow
ODOR	:	Irritating
pH	:	Strong acid <1
BOILING POINT	:	85^0 C
FLASH POINT	;	Not determined
SPECIFIC GRAVITY	:	1.150 -1.164
VAPOR PRESSURE	:	20 hPa @ 20^0 C
SOLUBILITY IN	:	WATER: miscible, BASE : miscible

X. STABILITY AND REACTIVITY

Stability : Stable under normal handling conditions.
Hazardous polymerization will not occur.
Hazardous decomposition product: HCl gas will not decompose.
Materials and conditions to avoid (incompatibility) are:
Avoid high temperatures. Containers may burst. Corrosive to most metals, concrete, some plastics, some rubber and coatings. Fumes forms droplets which settle and promote corrosion of metals and unprotected equipment. Mixing with strong acids can cause evolution of hydrogen chloride gas. Oxidizing agents will cause the release of toxic chlorine gas. Contact of liquid acid or gas with alkali or active metal may develop enough heat to cause fire in adjacent combustible material.

XI. TOXICOLOGICAL INFORMATION

Reproductive Effects: No data available
MUTAGENICITY : Not applicable
CANCER INFORMATION : Not applicable

XII. ECOLOGICAL INFORMATION

ECOTOXICITY DATA: High acidity may pose potential hazard to plant and marine life.
WATER-POLLUTION RISK CLASSIFICATION: Slightly water-polluting substance.

XIII. DISPOSAL CONSIDERATIONS

Dispose of in accordance with all Government and Local regulations.

XIV. TRANSPORT INFORMATION

Transportation of Dangerous Goods
TDG Classification: Do not ship by air.
DOT Hazard Classification: Class 8 : Corrosive: Group II
DOT Shipping Name : Hydrochloric acid ID: UN 1789

XV. REGULATORY INFORMATION

No data available

XVI OTHER INFORMATION

This MSDS contains information under the sixteen (16) section headings required by ISO 11014 “Safety Data Sheet for Chemical Products”.

GASCO

MATERIAL SAFETY DATA SHEET - CALIBRATION CHECK GAS

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR

MSDS NO: 248 **Version:3** **Date: March, 2012**

1. Chemical Product and Company Identification

Gasco Affiliates, LLC
320 Scarlett Blvd.
Oldsmar, FL 34677

TELEPHONE NUMBER: (800) 910-0051 **24-HOUR EMERGENCY NUMBER: 1-800-424-9300**
FAX NUMBER: (866) 755-8920
E-MAIL: info@gascogas.com

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR
CHEMICAL NAME: Isobutylene in air
COMMON NAMES/ SYNONYMS: None
TDG (Canada) CLASSIFICATION: 2.2
WHIMIS CLASSIFICATION: A

2. COMPOSITION/ INFORMATION ON INGREDIENTS

INGREDIENT	%VOLUME	PEL-OSHA	TLV-ACGIH	LD_{50} or LC_{50} Route/Species
Isobutylene FORMULA: C_4H_8	0.0001-0.9	N/A	N/A	N/A
Air FORMULA: Mixture	99.0 to 99.9999	N/A	N/A	N/A

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Release of this product may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly ventilated environments); individuals in such atmospheres may be asphyxiated. Isobutylene may cause drowsiness and other central nervous system effects in high concentrations; however, due to the low concentration of this gas mixture, this is unlikely to occur.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
No	No	No	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization	Reproductive Hazard	Mutagen
Yes	No	No	No	No

Carcinogenicity: --NTP: No IARC: No OSHA: No

EYE EFFECTS:
N/A.

SKIN EFFECTS:
N/A.

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR

INGESTION EFFECTS:
Ingestion unlikely. Gas at room temperature.

INHALATION EFFECTS:
Due to the small size of this cylinder, no unusual health effects from over-exposure are anticipated under normal routine use.

NFPA HAZARD CODES		HMIS HAZARD CODES		RATING SYSTEM
Health:	1	Health:	1	0= No Hazard
Flammability:	0	Flammability:	0	1= Slight Hazard
Reactivity:	0	Reactivity:	0	2= Moderate Hazard
				3= Serious Hazard
				4= Severe Hazard

4. FIRST AID MEASURES

EYES:
N/A

SKIN:
N/A

INGESTION:
Not required

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASED OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED THE SELF-CONTAINED BREATHING APPARATUS. Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. If breathing has stopped administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. FIRE-FIGHTING MEASURES

These containers hold gas under pressure, with no liquid phase. If involved in a major fire, they should be sprayed with water to avoid pressure increases, otherwise pressures will rise and ultimately they may distort or burst to release the contents. The gases will not add significantly to the fire, but containers or fragments may be projected considerable distances - thereby hampering fire fighting efforts.

6. ACCIDENTAL RELEASE MEASURES

In terms of weight, these containers hold very little contents, such that any accidental release by puncturing etc. will be of no practical concern.

7. HANDLING AND STORAGE

Suck back of water into the container must be prevented. Do not allow backfeed into the container. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Use only in well-ventilated areas. Do not heat cylinder by any means to increase rate of product from the cylinder. Do not allow the temperature where cylinders are stored to exceed 130^{o}F (54^{o}C).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Use adequate ventilation for extended use of gas.

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR

9. PHYSICAL AND CHEMICAL PROPERTIES

PARAMETER:	VALUE:
Physical state	: Gas
Evaporation point	: N/A
pH	: N/A
Odor and appearance	: Colorless, odorless gas

10. STABILITY AND REACTIVITY

Stable under normal conditions. Expected shelf life 48 months.

11. TOXICOLOGICAL INFORMATION

No toxicological damage caused by this product.

12. ECOLOGICAL INFORMATION

No ecological damage caused by this product.

13. DISPOSAL INFORMATION

Do not discharge into any place where its accumulation could be dangerous. Used containers are acceptable for disposal in the normal waste stream as long as the cylinder is empty and valve removed or cylinder wall is punctured; but GASCO encourages the consumer to return cylinders.

14. TRANSPORT INFORMATION

	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Compressed Gas N.O.S. (Isobutylene in Air)	Compressed Gas N.O.S. (Isobutylene in Air)
HAZARD CLASS:	2.2	2.2
IDENTIFICATION NUMBER:	UN1956	UN1956
SHIPPING LABEL:	NONFLAMMABLE GAS	NONFLAMMABLE GAS

15. REGULATORY INFORMATION

Isobutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

16. OTHER INFORMATION

This MSDS has been prepared in accordance with the Chemicals (Hazard Information and Packaging for Supply (Amendment) Regulation 1996. The information is based on the best knowledge of GASCO, and its advisors and is given in good faith, but we cannot guarantee its accuracy, reliability or completeness and therefore disclaim any liability for loss or damage arising out of use of this data. Since conditions of use are outside the control of the Company and its advisors we disclaim any liability for loss or damage when the product is used for other purposes than it is intended.

MSDS/S010/248/ March, 2012

QUIKRETE®
CEMENT & CONCRETE PRODUCTS™

Portland Cement Based Concrete Products

MATERIAL SAFETY DATA SHEET
(Complies with OSHA 29 CFR 1910.1200)

SECTION I: PRODUCT IDENTIFICATION

The QUIKRETE® Companies
One Securities Centre
3490 Piedmont Road, Suite 1300
Atlanta, GA 30329

Emergency Telephone Number
(770) 216-9580

Information Telephone Number
(770) 216-9580

MSDS J1
Revision: May-12

QUIKRETE® Product Name	Code #
CONCRETE MIX	1101
FENCE POST MIX	1005
FIBER-REINFORCED CONCRETE MIX	1006
CRACK RESISTANT CONCRETE MIX	1006-80
QUIKRETE 5000 CONCRETE MIX	1007
QUIKRETE 6000 CONCRETE MIX	1007
LIGHTWEIGHT CONCRETE MIX	1008
HANDICRETE CONCRETE MIX	1141
MAXIMUM YIELD CONCRETE MIX	1100-80
B-CRETE	1101-81
PRO-FINISH QUIKRETE 5000	1007-85
BASIC CONCRETE MIX	1015
RIP RAP	1129
ALL-STAR CONCRETE MIX	1121
ALL-STAR CRACK RESISTANT CONCRETE MIX	1470-03
ALL-STAR 5000 CONCRETE MIX	1470-01
RED-E-CRETE CONCRETE MIX	1101-91, -87
RIP RAP SCRIM	1134-80
FIBER REINFORCED DECK MIX	1251-80, -81
PRO-FINISH CRACK RESISTANT CONCRETE MIX	1006-68
COUNTERTOP MIX	1106-80
RITEMIX CONCRETE	1171-60
GREEN CONCRETE MIX	1101-63, -73

Product Use: Portland cement-based, aggregated products for general construction

SECTION II - HAZARD IDENTIFICATION

Route(s) of Entry: Inhalation, Skin, Ingestion

Acute Exposure: Product becomes alkaline when exposed to moisture. Exposure can dry the skin, cause alkali burns and affect the mucous membranes. Dust can irritate the eyes and upper respiratory system. Toxic effects noted in animals include, for acute exposures, alveolar damage with pulmonary edema.

Chronic Exposure: Dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis.

Carcinogenicity: Since Portland cement and blended cements are manufactured from raw materials mined from the earth (limestone, marl, sand, shale, etc.) and process heat is provided by burning fossil fuels, trace, but detectable, amounts of naturally occurring, and possibly harmful, elements may be found during chemical analysis. Under ASTM standards, Portland cement may contain 0.75 % insoluble residue. A fraction of these residues may be free crystalline silica. Respirable crystalline silica (quartz) can cause silicosis, a fibrosis (scarring) of the lungs and possibly cancer. There is evidence that exposure to respirable silica or the disease silicosis is associated with an increased incidence of Scleroderma, tuberculosis and kidney disorders.

Carcinogenicity Listings:		
	NTP:	Known carcinogen
	OSHA:	Not listed as a carcinogen
	IARC Monographs:	Group 1 Carcinogen
	California Proposition 65:	Known carcinogen

NTP: The National Toxicology Program, in its "Ninth Report on Carcinogens" (released May 15, 2000) concluded that "Respirable crystalline silica (RCS), primarily quartz dusts occurring in industrial and occupational settings, is *known to be a human carcinogen*, based on sufficient evidence of carcinogenicity from studies in humans indicating a causal relationship between exposure to RCS and increased lung cancer rates in workers exposed to crystalline silica dust (reviewed in IAC, 1997; Brown *et al*., 1997; Hind *et al*., 1997)

IARC: The International Agency for Research on Cancer ("IARC") concluded that there was "*sufficient evidence* in humans for the carcinogenicity of crystalline silica in the forms of quartz or cristobalite from occupational sources", and that there is "*sufficient evidence* in experimental animals for the carcinogenicity of quartz or cristobalite." The overall IARC evaluation was that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is *carcinogenic to humans (*Group 1)." The IARC evaluation noted that "carcinogenicity was not detected in all industrial circumstances or studies. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." For further information on the IARC evaluation, see IARC Monographs on the Evaluation of carcinogenic Risks to Humans, Volume 68, "Silica, Some Silicates." (1997)

Signs and Symptoms of Exposure: Symptoms of excessive exposure to the dust include shortness of breath and reduced pulmonary function. Excessive exposure to skin and eyes especially when mixed with water can cause caustic burns as severe as third degree.

Medical Conditions Generally Aggravated by Exposure: Individuals with sensitive skin and with pulmonary and/or respiratory disease, including, but not limited to, asthma and bronchitis, or subject to eye irritation, should be precluded from exposure. Exposure to crystalline silica or the disease silicosis is associated with increased incidence of scleroderma, Tuberculosis and possibly increased incidence of kidney lesions.

Chronic Exposure: Dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis. (May contain trace (<0.05 %) amounts of chromium salts or compounds including hexavalent chromium, or other metals found to be hazardous or toxic in some chemical forms. These metals are mostly present as trace substitutions within the principal minerals)

Medical Conditions Generally Aggravated by Exposure: Individuals with sensitive skin and with pulmonary and/or respiratory disease, including, but not limited to, asthma and bronchitis, or subject to eye irritation, should be precluded from exposure.

SECTION III - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components	CAS No.	%	PEL (OSHA) mg/M^3	TLV (ACGIH) mg/M^3
Portland Cement	65997-15-1	10-30	5	5
Lime	01305-62-0	0-5	5	5
Silica Sand, crystalline	14808-60-7	70-90	$\frac{10}{\%SiO_2+2}$	0.05 (respirable)
May contain one or more of the following ingredients:				
Amorphous Silica (From fly Ash)	07631-86-9	$\frac{80}{\%SiO_2+2}$	10	
Alumina (From Fly Ash)	01344-28-1	5	5	
Limestone Dust	01317-65-3	5	5	
Calcium Sulfate	10101-41-4 or 13397-24-5	5	5	

Other Limits: National Institute for Occupational Safety and Health (NIOSH). Recommended standard maximum permissible concentration=0.05 mg/M^3 (respirable free silica) as determined by a full-shift sample up to 10-hour working day, 40-hour work week. See NIOSH Criteria for a Recommended Standard Occupational Exposure to Crystalline Silica.

SECTION IV – First Aid Measures

Eyes: Immediately flush eye thoroughly with water. Continue flushing eye for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.
Skin: Wash skin with cool water and pH-neutral soap or a mild detergent. Seek medical treatment if irritation or inflammation develops or persists. Seek immediate medical treatment in the event of burns.
Inhalation: Remove person to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. Seek medical help if coughing and other symptoms do not subside. Inhalations of large amounts of Portland cement require immediate medical attention.
Ingestion: Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

SECTION V - FIRE AND EXPLOSION HAZARD DATA

Flammability: Noncombustible and not explosive.
Auto-ignition Temperature: Not Applicable
Flash Points: Not Applicable

SECTION VI – ACCIDENTAL RELEASE MEASURES

If spilled, use dustless methods (vacuum) and place into covered container for disposal (if not contaminated or wet). Use adequate ventilation to keep exposure to airborne contaminants below the exposure limit.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND STORAGE

Do not allow water to contact the product until time of use. DO NOT BREATHE DUST. In dusty environments, the use of an OSHA, MSHA or NIOSH approved respirator and tight fitting goggles is recommended.

SECTION VIII – EXPOSURE CONTROL MEASURES

Engineering Controls: Local exhaust can be used, if necessary, to control airborne dust levels.

Personal Protection: The use of barrier creams or impervious gloves, boots and clothing to protect the skin from contact is recommended. Following work, workers should shower with soap and water. Precautions must be observed because burns occur with little warning -- little heat is sensed.

WARN EMPLOYEES AND/OR CUSTOMERS OF THE HAZARDS AND REQUIRED OSHA PRECAUTIONS ASSOCIATED WITH THE USE OF THIS PRODUCT.

Exposure Limits: Consult local authorities for acceptable exposure limits

SECTION IX - PHYSICAL/CHEMICAL CHARACTERISTICS

Appearance: Gray to gray-brown colored powder; Some products contain coarse aggregates.

Specific Gravity:	2.6 to 3.15	**Melting Point:**	>2700°F
Boiling Point:	>2700°F	**Vapor Pressure:**	Not Available
Vapor Density:	Not Available	**Evaporation Rate:**	Not Available
Solubility in Water:	Slight	**Odor:**	Not Available
pH:	13 (10%)	**Volatile Organic Content (VOC):**	0 g/L

SECTION X - REACTIVITY DATA

Stability: Stable.
Incompatibility (Materials to Avoid): Contact of silica with powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, or oxygen difluoride may cause fires
Hazardous Decomposition or By-products: Silica will dissolve in Hydrofluoric Acid and produce a corrosive gas – silicon tetrafluoride.
Hazardous Polymerization: Will Not Occur.
Condition to Avoid: Keep dry until used to preserve product utility.

SECTION XI – TOXICOLOGICAL INFORMATION

Routes of Entry: Inhalation, Ingestion
Toxicity to Animals:
LD50: Not Available
LC50: Not Available
Chronic Effects on Humans: Conditions aggravated by exposure include eye disease, skin disorders and Chronic Respiratory conditions.
Special Remarks on Toxicity: Not Available

SECTION XII – ECOLOGICAL INFORMATION

Ecotoxicity: Not Available
BOD5 and COD: Not Available
Products of Biodegradation: Not available
Toxicity of the Products of Biodegradation: Not available
Special Remarks on the Products of Biodegradation: Not available

SECTION XIII – DISPOSAL CONSIDERATIONS

Waste Disposal Method: The packaging and material may be land filled; however, material should be covered to minimize generation of airborne dust. This product is not classified as a hazardous waste under the authority of the RCRA (40CFR 261) or CERCLA (40CFR 117&302).

SECTION XIV – TRANSPORT INFORMATION

Not hazardous under U.S. DOT and TDG regulations.

SECTION XV – OTHER REGULATORY INFORMATION

US OSHA 29CFR 1910.1200: Considered hazardous under this regulation and should be included in the employers' hazard communication program
SARA (Title III) Sections 311 & 312: Qualifies as a hazardous substance with delayed health effects
SARA (Title III) Section 313: Not subject to reporting requirements
TSCA (May 1997): Some substances are on the TSCA inventory list
Federal Hazardous Substances Act: Is a hazardous substance subject to statues promulgated under the subject act
California Regulation: WARNING: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.
Canadian Environmental Protection Act: Not listed
Canadian WHMIS Classification: Considered to be a hazardous material under the Hazardous Products Act as defined by the Controlled Products Regulations (Class D2A, E- Corrosive Material) and subject to the requirements of Health Canada's Workplace Hazardous Material Information (WHMIS). This product has been classified according to the hazard criteria of the Controlled Products Regulation (CPR). This document complies with the WHMIS requirements of the Hazardous Products Act (HPA) and the CPR.

SECTION XVI – OTHER INFORMATION

HMIS-III: Health –
0 = No significant health risk
1 = Irritation or minor reversible injury possible
2 = Temporary or minor injury possible
3 = Major injury possible unless prompt action is taken
4 = Life threatening, major or permanent damage possible

Flammability-
0 = Material will not burn
1 = Material must be preheated before ignition will occur
2 = Material must be exposed to high temperatures before ignition

	3 = Material capable of ignition under normal temperatures
	4 = Flammable gases or very volatile liquids; may ignite spontaneously
Physical Hazard-	0 = Material is normally stable, even under fire conditions
	1 = Material normally stable but may become unstable at high temps
	2 = Materials that are unstable and may undergo react at room temp
	3 = Materials that may form explosive mixtures with water
	4 = Materials that are readily capable of explosive water reaction

Abbreviations:

ACGIH	American Conference of Government Industrial Hygienists
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CPR	Controlled Products Regulations (Canada)
DOT	Department of Transportation
IARC	International Agency for Research
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicity Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
TLV	Threshold Limit Value
TWA	Time-weighted Average
WHMIS	Workplace Hazardous Material Information System

Last Updated: May 8, 2012

NOTE: The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to silica contained in our products. END OF MSDS.

APPENDIX C

Spill Prevention Control and Countermeasures (SPCC) Plan

U.S. ENVIRONMENTAL PROTECTION AGENCY
TIER I QUALIFIED FACILITY SPCC PLAN TEMPLATE

Instructions to Complete this Template

This template is intended to help the owner or operator of a Tier I qualified facility develop a self-certified Spill Prevention, Control, and Countermeasure (SPCC) Plan. To use this template, your facility must meet all of the applicability criteria of a Tier I qualified facility listed under §112.3(g)(1) of the SPCC rule. This template provides every SPCC rule requirement necessary for a Tier I qualified facility, which you must address and implement.

You may use this template to comply with the SPCC regulation or use it as a model and modify it as necessary to meet your facility-specific needs. If you modify the template, your Plan must include a section cross-referencing the location of each applicable requirement of the SPCC rule and you must ensure that your Plan is an equivalent Plan that meets all applicable rule requirements of 40 CFR 112.6(a)(3).

You may complete this template either electronically or by hand on a printed copy. This document is a reformatted version of the template found in Appendix G of 40 CFR part 112.[a] No substantive changes have been made. Please note that a "Not Applicable" ("N/A") column has been added to both Table G-10 (General Rule Requirements for Onshore Facilities) and Table G-11 (General Rule Requirements for Onshore Oil Production Facilities). The "N/A" column should help you complete your self-certification when a required rule element does not apply to your facility. Use of the "N/A" column is optional and is not required by rule.

All Tier I qualified facility self-certifiers must complete Sections I, II, and III. Additionally, the owner or operator of an:

- Onshore facility (excluding production) must complete Section A.
- Onshore oil production facility (excluding drilling and workover facilities) must complete Section B.
- Onshore oil drilling and workover facility must complete Section C.

Complete and include with your Plan the appropriate attachments. You should consider printing copies of the attachments for use in implementing the SPCC Plan (e.g. Attachment 3.1 - Inspection Log & Schedule; Attachment 4 - Discharge Notification Form).

To complete the template, check the box next to the requirement to indicate that it has been adequately addressed. Either write “N/A” in the column or check the box under the “N/A” column to indicate those requirements that are not applicable to the facility. Where a section requires a description or listing, write in the spaces provided (or attach additional descriptions if more space is needed).

Below is a key for the colors used in the section headers:

Sections I, II, and III: Required for all Tier I qualified facilities
Section A: Onshore facilities (excluding production)
Section B: Onshore oil production facilities (excluding drilling and workover facilities)
Section C: Onshore oil drilling and workover facilities
Attachments: 1 - Five Year Review and Technical Amendment Logs 2 - Oil Spill Contingency Plan and Checklist 3 - Inspections, Dike Drainage and Personnel Training Logs 4 - Discharge Notification Form

After you have completed all appropriate sections, certify and date your Plan, and then implement it by the compliance date. If your facility was in operation before August 16, 2002, and you do not already have a Plan, then implement this template immediately. Conduct inspections and tests in accordance with the written procedures that you have developed for your facility. You must keep with the SPCC Plan a record of these inspections and tests, signed by the appropriate supervisor or inspector, for a period of three years.

Do not forget to periodically review your Plan (at least once every five years) or to update it when you make changes to your facility. You must prepare amendments within six months of the facility change, and implement them as soon as possible, but not later than six months following preparation of any amendment.

In the event that your facility releases oil to navigable waters or adjoining shorelines, immediately call the National Response Center (NRC) at 1-800-424-8802. The NRC is the federal government's centralized reporting center, which is staffed 24 hours per day by U.S. Coast Guard personnel.

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[a] Please note that the use of this template is not mandatory for a Tier I qualified facility. You may also meet the SPCC Plan requirement by preparing a satisfactory Tier II qualified facility Plan, preparing a satisfactory Plan that is certified by a Professional Engineer, or by developing an equivalent Plan for a Tier I qualified facility. Further information on the requirements of these methods can be found in 40 CFR part 112.6(a)(1). If you use any of these alternative methods you must include a cross reference in your Plan that shows how the equivalent Plan meets all applicable 40 CFR part 112 requirements.

Tier I Qualified Facility SPCC Plan

This template constitutes the SPCC Plan for the facility, when completed and signed by the owner or operator of a facility that meets the applicability criteria in §112.3(g)(1). This template addresses the requirements of 40 CFR part 112. Maintain a complete copy of the Plan at the facility if the facility is normally attended at least four hours per day, or for a facility attended fewer than four hours per day, at the nearest field office. When making operational changes at a facility that are necessary to comply with the rule requirements, the owner/operator should follow state and local requirements (such as for permitting, design and construction) and obtain professional assistance, as appropriate.

Facility Description

Facility Name: Operable Unit 2 North Penn Area 5 Superfund Site (NP5OU2 Superfund Site)

Facility Address: Unilateral Administrative Order CERCLA Docket No. CERCLA-03-2012-0205DC

City: Colmar State: PA ZIP: 18915

County: Montgomery/Bucks Tel. Number: Not applicable

Owner or Operator Name: NP5OU2 Superfund Site

Owner or Operator Address: Unilateral Administrative Order CERCLA Docket No. CERCLA-03-2012-0205DC

City: Colmar State: PA ZIP: 18915

County: Montgomery/Bucks Tel. Number: Not applicable

I. Self-Certification Statement (§112.6(a)(1))

The owner or operator of a facility certifies that each of the following is true in order to utilize this template to comply with the SPCC requirements:

I _____ certify that the following is accurate:

1. I am familiar with the applicable requirements of 40 CFR part 112;
2. I have visited and examined the facility;
3. This Plan was prepared in accordance with accepted and sound industry practices and standards;
4. Procedures for required inspections and testing have been established in accordance with industry inspection and testing standards or recommended practices;
5. I will fully implement the Plan;
6. This facility meets the following qualification criteria (under §112.3(g)(1)):
    a. The aggregate aboveground oil storage capacity of the facility is 10,000 U.S. gallons or less; and
    b. The facility has had no single discharge as described in §112.1(b) exceeding 1,000 U.S. gallons and no two discharges as described in §112.1(b) each exceeding 42 U.S. gallons within any twelve month period in the three years prior to the SPCC Plan self-certification date, or since becoming subject to 40 CFR part 112 if the facility has been in operation for less than three years (not including oil discharges as described in §112.1(b) that are the result of natural disasters, acts of war, or terrorism); and
    c. There is no individual oil storage container at the facility with an aboveground capacity greater than 5,000 U.S. gallons.
7. This Plan does not deviate from any requirement of 40 CFR part 112 as allowed by §112.7(a)(2) (environmental equivalence) and §112.7(d) (impracticability of secondary containment) or include any measures pursuant to §112.9(c)(6) for produced water containers and any associated piping;
8. This Plan and individual(s) responsible for implementing this Plan have the full approval of management and I have committed the necessary resources to fully implement this Plan.

I also understand my other obligations relating to the storage of oil at this facility, including, among others:

1. To report any oil discharge to navigable waters or adjoining shorelines to the appropriate authorities. Notification information is included in this Plan.
2. To review and amend this Plan whenever there is a material change at the facility that affects the potential for an oil discharge, and at least once every five years. Reviews and amendments are recorded in an attached log [See Five Year Review Log and Technical Amendment Log in Attachments 1.1 and 1.2.]
3. Optional use of a contingency plan. A contingency plan:
    a. May be used in lieu of secondary containment for qualified oil-filled operational equipment, in accordance with the requirements under §112.7(k), and;
    b. Must be prepared for flowlines and/or intra-facility gathering lines which do not have secondary containment at an oil production facility, and;
    c. Must include an established and documented inspection or monitoring program; must follow the provisions of 40 CFR part 109; and must include a written commitment of manpower, equipment and materials to expeditiously remove any quantity of oil discharged that may be harmful. If applicable, a copy of the contingency plan and any additional documentation will be attached to this Plan as Attachment 2.

I certify that I have satisfied the requirement to prepare and implement a Plan under §112.3 and all of the requirements under §112.6(a). I certify that the information contained in this Plan is true.

Signature _____ Title: _____

Name _____ Date: 3/18/2013

II. Record of Plan Review and Amendments

Five Year Review (§112.5(b)):

Complete a review and evaluation of this SPCC Plan at least once every five years. As a result of the review, amend this Plan within six months to include more effective prevention and control measures for the facility**,** if applicable. Implement any SPCC Plan amendment as soon as possible**,** but no later than six months following Plan amendment. Document completion of the review and evaluation, and complete the Five Year Review Log in Attachment 1.1. If the facility no longer meets Tier I qualified facility eligibility, the owner or operator must revise the Plan to meet Tier II qualified facility requirements, or complete a full PE certified Plan.

Table G-1 Technical Amendments (§§112.5(a), (c) and 112.6(a)(2))	
This SPCC Plan will be amended when there is a change in the facility design, construction, operation, or maintenance that materially affects the potential for a discharge to navigable waters or adjoining shorelines. Examples include adding or removing containers, reconstruction, replacement, or installation of piping systems, changes to secondary containment systems, changes in product stored at this facility, or revisions to standard operating procedures.	☐
Any technical amendments to this Plan will be re-certified in accordance with Section I of this Plan template. *[§112.6(a)(2)]* **[See Technical Amendment Log in Attachment 1.2]**	☐

III. Plan Requirements

1. Oil Storage Containers (§112.7(a)(3)(i)):

Table G-2 Oil Storage Containers and Capacities	
This table includes a complete list of all oil storage containers (aboveground containers[a] and completely buried tanks[b]) with capacity of 55 U.S. gallons or more, unless otherwise exempt from the rule. For mobile/portable containers, an estimated number of containers, types of oil, and anticipated capacities are provided.	☒

Oil Storage Container *(indicate whether aboveground (A) or completely buried (B))*	**Type of Oil**	**Shell Capacity (gallons)**
Not applicable – no oil storage necessary during completion RD field activities. Only storage will be investigation derived waste (IDW) for groundwater and soils/rock.	Not applicable	0

Total Aboveground Storage Capacity [c] 0 gallons
Total Completely Buried Storage Capacity 0 gallons
Facility Total Oil Storage Capacity 0 gallons

[a] Aboveground storage containers that must be included when calculating total facility oil storage capacity include: tanks and mobile or portable containers; oil-filled operational equipment (e.g. transformers); other oil-filled equipment**,** such as flow-through process equipment. Exempt containers that are not included in the capacity calculation include: any container with a storage capacity of less than 55 gallons of oil; containers used exclusively for wastewater treatment; permanently closed containers; motive power containers; hot-mix asphalt containers; heating oil containers used solely at a single-family residence; and pesticide application equipment or related mix containers.

[b] Although the criteria to determine eligibility for qualified facilities focuses on the aboveground oil storage containers at the facility, the completely buried tanks at a qualified facility are still subject to the rule requirements and must be addressed in the template; however, they are not counted toward the qualified facility applicability threshold.

[c] Counts toward qualified facility applicability threshold.

2. Secondary Containment and Oil Spill Control (§§112.6(a)(3)(i) and (ii), 112.7(c) and 112.9(c)(2)):

Table G-3 Secondary Containment and Oil Spill Control	
Appropriate secondary containment and/or diversionary structures or equipment[a] is provided for all oil handling containers, equipment, and transfer areas to prevent a discharge to navigable waters or adjoining shorelines. The entire secondary containment system, including walls and floor, is capable of containing oil and is constructed so that any discharge from a primary containment system, such as a tank or pipe, will not escape the containment system before cleanup occurs.	☐

[a] Use one of the following methods of secondary containment or its equivalent: (1) Dikes, berms, or retaining walls sufficiently impervious to contain oil; (2) Curbing; (3) Culverting, gutters, or other drainage systems; (4) Weirs, booms, or other barriers; (5) Spill diversion ponds; (6) Retention ponds; or (7) Sorbent materials.

Table G-4 below identifies the tanks and containers at the facility with the potential for an oil discharge; the mode of failure; the flow direction and potential quantity of the discharge; and the secondary containment method and containment capacity that is provided.

Table G-4 Containers with Potential for an Oil Discharge

Area	Type of failure (discharge scenario)	Potential discharge volume (gallons)	Direction of flow for uncontained discharge	Secondary containment method[a]	Secondary containment capacity (gallons)
Bulk Storage Containers and Mobile/Portable Containers[b]					
Not applicable – no oil storage necessary during completion RD field activities. Only storage will be investigation derived waste (IDW) for groundwater and soils/rock.	Not applicable	0			0
Oil-filled Operational Equipment (e.g., hydraulic equipment, transformers)[c]					
Drill Rig and support vehicle	Fitting leak, valve, hose	< 1	Radial	None	0
Compressor	Fitting leak, valve, hose	< 1	Radial	None	0
Piping, Valves, etc.					
None					
Product Transfer Areas (location where oil is loaded to or from a container, pipe or other piece of equipment.)					
Drum storage area	Overfill/spill during transfer from sample bucket to drum	< 1	Radial	None	0
None					
Other Oil-Handling Areas or Oil-Filled Equipment (e.g. flow-through process vessels at an oil production facility)					
None					

[a] Use one of the following methods of secondary containment or its equivalent: (1) Dikes, berms, or retaining walls sufficiently impervious to contain oil; (2) Curbing; (3) Culverting, gutters, or other drainage systems; (4) Weirs, booms, or other barriers; (5) Spill diversion ponds; (6) Retention ponds; or (7) Sorbent materials.

[b] For storage tanks and bulk storage containers, the secondary containment capacity must be at least the capacity of the largest container plus additional capacity to contain rainfall or other precipitation.

[c] For oil-filled operational equipment: Document in the table above if alternative measures to secondary containment (as described in §112.7(k)) are implemented at the facility.

3. Inspections, Testing, Recordkeeping and Personnel Training (§§112.7(e) and (f), 112.8(c)(6) and (d)(4), 112.9(c)(3), 112.12(c)(6) and (d)(4)):

Table G-5 Inspections, Testing, Recordkeeping and Personnel Training	
An inspection and/or testing program is implemented for all aboveground bulk storage containers and piping at this facility. *[§§112.8(c)(6) and (d)(4), 112.9(c)(3), 112.12(c)(6) and (d)(4)]*	☒
The following is a description of the inspection and/or testing program (e.g. reference to industry standard utilized, scope, frequency, method of inspection or test, and person conducting the inspection) for all aboveground bulk storage containers and piping at this facility: 1) Competent personnel will complete visual inspections on a monthly basis of the steel drum storage area for Investigation Derived Waste (IDW). Extreme care will be taken when filling drums and moving drums to the Waste Management and Equipment Staging area on Site. 2) Drilling crew will complete visual inspections of drilling equipment on a daily basis.	
Inspections, tests, and records are conducted in accordance with written procedures developed for the facility. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph. *[§112.7(e)]*	☒
A record of the inspections and tests are kept at the facility or with the SPCC Plan for a period of three years. *[§112.7(e)]* **[See Inspection Log and Schedule in Attachment 3.1]**	☐
Inspections and tests are signed by the appropriate supervisor or inspector. *[§112.7(e)]*	☐
Personnel, training, and discharge prevention procedures [§112.7(f)]	
Oil-handling personnel are trained in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC Plan. *[§112.7(f)]*	☐
A person who reports to facility management is designated and accountable for discharge prevention. *[§112.7(f)]* Name/Title: _____	☐
Discharge prevention briefings are conducted for oil-handling personnel annually to assure adequate understanding of the SPCC Plan for that facility. Such briefings highlight and describe past reportable discharges or failures, malfunctioning components, and any recently developed precautionary measures. *[§112.7(f)]* **[See Oil-handling Personnel Training and Briefing Log in Attachment 3.4]**	☐

4. Security (excluding oil production facilities) §112.7(g):

Table G-6 Implementation and Description of Security Measures	
Security measures are implemented at this facility to prevent unauthorized access to oil handling, processing, and storage area.	☐

The following is a description of how you secure and control access to the oil handling, processing and storage areas; secure master flow and drain valves; prevent unauthorized access to starter controls on oil pumps; secure out-of-service and loading/unloading connections of oil pipelines; address the appropriateness of security lighting to both prevent acts of vandalism and assist in the discovery of oil discharges:

Not applicable.

5. Emergency Procedures and Notifications (§112.7(a)(3)(iv) and 112.7(a)(5)):

Table G-7 Description of Emergency Procedures and Notifications

The following is a description of the immediate actions to be taken by facility personnel in the event of a discharge to navigable waters or adjoining shorelines *[§112.7(a)(3)(iv) and 112.7(a)(5)]*:

Not applicable, as work effort within land locked area of Pennsylvania.

6. Contact List (§112.7(a)(3)(vi)):

Table G-8 Contact List	
Contact Organization / Person	**Telephone Number**
National Response Center (NRC)	1-800-424-8802
Cleanup Contractor(s) Not applicable	Not applicable
Key Facility Personnel	
Designated Person Accountable for Discharge Prevention: Derek Tomlinson, Project Coordinator	Office: (267) 464-2800 ext 9025
	Emergency: (267) 218-0835 (cell)
Michelle Mirigliano, Field Manager	Office: (267) 464-2800 ext 9031
	Emergency: (215) 380-9524 (cell)
	Office:
	Emergency:
	Office:
	Emergency:
State Oil Pollution Control Agencies PADEP Emergency Response – Southeast Region	(484) 250-5900
Other State, Federal, and Local Agencies EPA Region III	(800) 438-2474
Local Fire Department Chalfont Fire Company	(215) 822-9685 / 911
Local Police Department Chalfont Police Department	911
Hospital Doylestown Hospital-595 West State Street, Doylestown, PA	(215) 345-2200
Other Contact References (e.g., downstream water intakes or neighboring facilities) On-Site Contact – Constantia Colmar, Inc. – Richard Kleckner	(215) 997-6222

7. NRC Notification Procedure (§112.7(a)(4) and (a)(5)):

Table G-9 NRC Notification Procedure	
In the event of a discharge of oil to navigable waters or adjoining shorelines, the following information identified in Attachment 4 will be provided to the National Response Center immediately following identification of a discharge to navigable waters or adjoining shorelines **[See Discharge Notification Form in Attachment 4]**: *[§112.7(a)(4)]*	☒

- The exact address or location and phone number of the facility;
- Date and time of the discharge;
- Type of material discharged;
- Estimate of the total quantity discharged;
- Estimate of the quantity discharged to navigable waters;
- Source of the discharge;
- Description of all affected media;
- Cause of the discharge;
- Any damages or injuries caused by the discharge;
- Actions being used to stop, remove, and mitigate the effects of the discharge;
- Whether an evacuation may be needed; and
- Names of individuals and/or organizations who have also been contacted.

8. SPCC Spill Reporting Requirements (Report within 60 days) (§112.4):

Submit information to the EPA Regional Administrator (RA) and the appropriate agency or agencies in charge of oil pollution control activities in the State in which the facility is located within 60 days from one of the following discharge events:

A single discharge of more than 1,000 U.S. gallons of oil to navigable waters or adjoining shorelines or
Two discharges to navigable waters or adjoining shorelines each more than 42 U.S. gallons of oil occurring within any twelve month period

You must submit the following information to the RA:

(1) Name of the facility;
(2) Your name;
(3) Location of the facility;
(4) Maximum storage or handling capacity of the facility and normal daily throughput;
(5) Corrective action and countermeasures you have taken, including a description of equipment repairs and replacements;
(6) An adequate description of the facility, including maps, flow diagrams, and topographical maps, as necessary;
(7) The cause of the reportable discharge, including a failure analysis of the system or subsystem in which the failure occurred; and
(8) Additional preventive measures you have taken or contemplated to minimize the possibility of recurrence
(9) Such other information as the Regional Administrator may reasonably require pertinent to the Plan or discharge

* * * * *

NOTE: Complete one of the following sections (A, B or C) as appropriate for the facility type.

A. Onshore Facilities (excluding production) (§§112.8(b) through (d), 112.12(b) through (d)):

The owner or operator must meet the general rule requirements as well as requirements under this section. Note that not all provisions may be applicable to all owners/operators. For example, a facility may not maintain completely buried metallic storage tanks installed after January 10, 1974, and thus would not have to abide by requirements in §§112.8(c)(4) and 112.12(c)(4), listed below. **In cases where a provision is not applicable, write "N/A".**

Table G-10 General Rule Requirements for Onshore Facilities		N/A
Drainage from diked storage areas is restrained by valves to prevent a discharge into the drainage system or facility effluent treatment system, except where facility systems are designed to control such discharge. Diked areas may be emptied by pumps or ejectors that must be manually activated after inspecting the condition of the accumulation to ensure no oil will be discharged. *[§§112.8(b)(1) and 112.12(b)(1)]*	☐	☒
Valves of manual, open-and-closed design are used for the drainage of diked areas. *[§§112.8(b)(2) and 112.12(b)(2)]*	☐	☒
The containers at the facility are compatible with materials stored and conditions of storage such as pressure and temperature. *[§§112.8(c)(1) and 112.12(c)(1)]*	☒	☐
Secondary containment for the bulk storage containers (including mobile/portable oil storage containers) holds the capacity of the largest container plus additional capacity to contain precipitation. Mobile or portable oil storage containers are positioned to prevent a discharge as described in §112.1(b). *[§112.6(a)(3)(ii)]*	☐	☒
If uncontaminated rainwater from diked areas drains into a storm drain or open watercourse the following procedures will be implemented at the facility: *[§§112.8(c)(3) and 112.12(c)(3)]*		
• Bypass valve is normally sealed closed	☐	☒
• Retained rainwater is inspected to ensure that its presence will not cause a discharge to navigable waters or adjoining shorelines	☐	☒
• Bypass valve is opened and resealed under responsible supervision	☐	☒
• Adequate records of drainage are kept **[See Dike Drainage Log in Attachment 3.3]**	☐	☒
For completely buried metallic tanks installed on or after January 10, 1974 at this facility *[§§112.8(c)(4) and 112.12(c)(4)]*:		
• Tanks have corrosion protection with coatings or cathodic protection compatible with local soil conditions.	☐	☒
• Regular leak testing is conducted.	☐	☒
For partially buried or bunkered metallic tanks *[§112.8(c)(5) and §112.12(c)(5)]*:		
• Tanks have corrosion protection with coatings or cathodic protection compatible with local soil conditions.	☐	☒
Each aboveground bulk container is tested or inspected for integrity on a regular schedule and whenever material repairs are made. Scope and frequency of the inspections and inspector qualifications are in accordance with industry standards. Container supports and foundations are regularly inspected. **[See Inspection Log and Schedule and Bulk Storage Container Inspection Schedule in Attachments 3.1 and 3.2]** *[§112.8(c)(6) and §112.12(c)(6)(i)]*	☐	☒
Outsides of bulk storage containers are frequently inspected for signs of deterioration, discharges, or accumulation of oil inside diked areas. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(c)(6) and 112.12(c)(6)]*	☐	☒
For bulk storage containers that are subject to 21 CFR part 110 which are shop-fabricated, constructed of austenitic stainless steel, elevated and have no external insulation, formal visual inspection is conducted on a regular schedule. Appropriate qualifications for personnel performing tests and inspections are documented. **[See Inspection Log and Schedule and Bulk Storage Container Inspection Schedule in Attachments 3.1 and 3.2]** *[§112.12(c)(6)(ii)]*	☐	☒

Table G-10 General Rule Requirements for Onshore Facilities		N/A
Each container is provided with a system or documented procedure to prevent overfills for the container. Describe:	☐	☒
Liquid level sensing devices are regularly tested to ensure proper operation **[See Inspection Log and Schedule in Attachment 3.1]**. *[§112.6(a)(3)(iii)]*	☐	☒
Visible discharges which result in a loss of oil from the container, including but not limited to seams, gaskets, piping, pumps, valves, rivets, and bolts are promptly corrected and oil in diked areas is promptly removed. *[§§112.8(c)(10) and 112.12(c)(10)]*	☐	☒
Aboveground valves, piping, and appurtenances such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces are inspected regularly. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(d)(4) and 112.12(d)(4)]*	☐	☒
Integrity and leak testing are conducted on buried piping at the time of installation, modification, construction, relocation, or replacement. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(d)(4) and 112.12(d)(4)]*	☐	☒

ATTACHMENT 1 – Five Year Review and Technical Amendment Logs

ATTACHMENT 1.1 – Five Year Review Log

I have completed a review and evaluation of the SPCC Plan for this facility, and will/will not amend this Plan as a result.

Table G-13 Review and Evaluation of SPCC Plan for Facility			
Review Date	Plan Amendment		Name and signature of person authorized to review this Plan
	Will Amend	Will Not Amend	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	

ATTACHMENT 1.2 – Technical Amendment Log

Any technical amendments to this Plan will be re-certified in accordance with Section I of this Plan template.

Table G-15 Description and Certification of Technical Amendments

Review Date	Description of Technical Amendment	Name and signature of person certifying this technical amendment

ATTACHMENT 2 – Oil Spill Contingency Plan and Checklist

An oil spill contingency plan and written commitment of resources is required for:

- Flowlines and intra-facility gathering lines at oil production facilities and
- Qualified oil-filled operational equipment which has no secondary containment.

An oil spill contingency plan meeting the provisions of 40 CFR part 109, as described below, and a written commitment of manpower, equipment and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful is attached to this Plan.	☐

Complete the checklist below to verify that the necessary operations outlined in 40 CFR part 109 - Criteria for State, Local and Regional Oil Removal Contingency Plans - have been included.

Table G-15 Checklist of Development and Implementation Criteria for State, Local and Regional Oil Removal Contingency Plans (§109.5)[a]	
(a) Definition of the authorities, responsibilities and duties of all persons, organizations or agencies which are to be involved in planning or directing oil removal operations.	☐
(b) Establishment of notification procedures for the purpose of early detection and timely notification of an oil discharge including:	
(1) The identification of critical water use areas to facilitate the reporting of and response to oil discharges.	☐
(2) A current list of names, telephone numbers and addresses of the responsible persons (with alternates) and organizations to be notified when an oil discharge is discovered.	☐
(3) Provisions for access to a reliable communications system for timely notification of an oil discharge, and the capability of interconnection with the communications systems established under related oil removal contingency plans, particularly State and National plans (e.g., NCP).	☐
(4) An established, prearranged procedure for requesting assistance during a major disaster or when the situation exceeds the response capability of the State, local or regional authority.	☐
(c) Provisions to assure that full resource capability is known and can be committed during an oil discharge situation including:	
(1) The identification and inventory of applicable equipment, materials and supplies which are available locally and regionally.	☐
(2) An estimate of the equipment, materials and supplies which would be required to remove the maximum oil discharge to be anticipated.	☐
(3) Development of agreements and arrangements in advance of an oil discharge for the acquisition of equipment, materials and supplies to be used in responding to such a discharge.	☐
(d) Provisions for well defined and specific actions to be taken after discovery and notification of an oil discharge including:	
(1) Specification of an oil discharge response operating team consisting of trained, prepared and available operating personnel.	☐
(2) Predesignation of a properly qualified oil discharge response coordinator who is charged with the responsibility and delegated commensurate authority for directing and coordinating response operations and who knows how to request assistance from Federal authorities operating under existing national and regional contingency plans.	☐
(3) A preplanned location for an oil discharge response operations center and a reliable communications system for directing the coordinated overall response operations.	☐
(4) Provisions for varying degrees of response effort depending on the severity of the oil discharge.	☐
(5) Specification of the order of priority in which the various water uses are to be protected where more than one water use may be adversely affected as a result of an oil discharge and where response operations may not be adequate to protect all uses.	☐
(6) Specific and well defined procedures to facilitate recovery of damages and enforcement measures as provided for by State and local statutes and ordinances.	☐

[a] The contingency plan must be consistent with all applicable state and local plans, Area Contingency Plans, and the National Contingency Plan (NCP)

ATTACHMENT 3 – Inspections, Dike Drainage and Personnel Training Logs

ATTACHMENT 3.1 – Inspection Log and Schedule

Table G-16 Inspection Log and Schedule

This log is intended to document compliance with §§112.6(a)(3)(iii), 112.8(c)(6), 112.8(d)(4), 112.9(b)(2), 112.9(c)(3), 112.9(d)(1), 112.9(d)(4), 112.12.(c)(6), and 112.12(d)(4), as applicable.

Date of Inspection	Container / Piping / Equipment	Describe Scope (or cite Industry Standard)	Observations	Name/ Signature of Inspector	Records maintained separately [a]
					☐
					☐
					☐
					☐
					☐

[a] Indicate in the table above if records of facility inspections are maintained separately at this facility.

ATTACHMENT 3.2 – Bulk Storage Container Inspection Schedule – onshore facilities (excluding production):

To comply with integrity inspection requirement for bulk storage containers, inspect/test each shop-built aboveground bulk storage container on a regular schedule in accordance with a recognized container inspection standard based on the minimum requirements in the following table.

Table G-17 Bulk Storage Container Inspection Schedule

Container Size and Design Specification	Inspection requirement
Portable containers (including drums, totes, and intermodal bulk containers (IBC))	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas
55 to 1,100 gallons with sized secondary containment	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas plus any annual inspection elements per industry inspection standards
1,101 to 5,000 gallons with sized secondary containment and a means of leak detection[a]	
1,101 to 5,000 gallons with sized secondary containment and no method of leak detection[a]	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas, plus any annual inspection elements and other specific integrity tests that may be required per industry inspection standards

[a] Examples of leak detection include, but are not limited to, double-walled tanks and elevated containers where a leak can be visually identified.

ATTACHMENT 3.3 – Dike Drainage Log

Table G-18 Dike Drainage Log						
Date	Bypass valve sealed closed	Rainwater inspected to be sure no oil (or sheen) is visible	Open bypass valve and reseal it following drainage	Drainage activity supervised	Observations	Signature of Inspector
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		

ATTACHMENT 3.4 – Oil-handling Personnel Training and Briefing Log

Table G-19 Oil-Handling Personnel Training and Briefing Log		
Date	**Description / Scope**	**Attendees**

ATTACHMENT 4 – Discharge Notification Form

In the event of a discharge of oil to navigable waters or adjoining shorelines, the following information will be provided to the National Response Center **[also see the notification information provided in Section 7 of the Plan]**:

Table G-20 Information provided to the National Response Center in the Event of a Discharge			
Discharge/Discovery Date		Time	
Facility Name	Operable Unit 2 North Penn Area 5 Superfund Site		
Facility Location (Address/Lat-Long/Section Township Range)	92 County Line Road, Colmar, PA 18915		
Name of reporting individual		Telephone #	
Type of material discharged		Estimated total quantity discharged	Gallons/Barrels
Source of the discharge		Media affected	☐ Soil ☐ Water (specify) ☐ Other (specify)
Actions taken			
Damage or injuries	☐ No ☐ Yes (specify)	Evacuation needed?	☐ No ☐ Yes (specify)
Organizations and individuals contacted	☐ National Response Center 800-424-8802 Time ☐ Cleanup contractor (Specify) Time ☐ Facility personnel (Specify) Time ☐ State Agency (Specify) Time ☐ Other (Specify) Time		

APPENDIX D

Geosyntec Standard Operating Procedures (SOPs)

STANDARD OPERATING PROCEDURE NO. 004

EQUIPMENT DECONTAMINATION

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

SOP No. 004

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STANDARD OPERATING PROCEDURE NO. 004

EQUIPMENT DECONTAMINATION PROCEDURES

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for decontamination of field equipment used in the investigation of sites with hazardous and potentially radiological waste.

1.1Objective

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to and between collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

1.2 Equipment

The following equipment may be utilized when decontaminating equipment. Site-specific conditions may warrant the use or deletion of items from this list.

- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap;
- Deionized water;
- Pump sprayer;
- 1-pint squeeze bottle filled with pesticide-grade hexane;
- 1-pint squeeze bottle filled with pesticide-grade methanol;
- 1-pint squeeze bottle filled with ten (10) percent nitric acid;
- 1-pint squeeze bottle filled with one (1) percent nitric acid;
- Five large plastic wash basins (24 inches by 30 inches by 6 inches deep);
- Two coarse scrub brushes;
- Small wire brush;
- Aluminum foil;
- Polyethylene sheeting;
- Two large capacity barrels;
- All necessary personal protective equipment (gloves, eyewear, tyveks);
- Extra quantities of above listed liquids;
- 4 inch Schedule 40 PVC pipe 4 feet in length with an end cap for decontaminating groundwater pumps and associated tubing (if needed); and

- High pressure sprayer with water supply.

2.0 PROCEDURES

2.1 General

The following procedures should be used for decontaminating field equipment. Procedures will vary with equipment used and potential contaminants present at the site.

2.2 Procedure for Soil Sampling Equipment

Soil sampling equipment, such as split spoon samplers, shovels, augers, trowels, spoons, and spatulas will be cleaned using the following procedure.

1. All tools being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a tool is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of the soap or rinsing the soap residue off the equipment will be difficult.

4. Using a clean coarse scrub brush, wash the sampling equipment in the soap solution in the first basin, removing all dirt. Be sure to wash inside surfaces of equipment as well as the exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin, using a coarse scrub brush or pressure sprayer to aid in the rinse, if necessary.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no samples for organic compounds are being collected, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or on appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed, then re-rerinse with deionized water.

16. If a tool that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the tool cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The tool shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field logbook. In this case, additional rinses with deionized water should be used and recorded.

2.3 Procedure for Ground Water Sampling Equipment

Ground water sampling equipment, such as bailers and stainless steel cord, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line, and provide an air drying area for equipment.

3. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of soap or rinsing the soap residue off the equipment will be difficult.

4. Wash the sampling equipment in the soap solution in the first basin, removing all residues. Be sure to wash inside surfaces of equipment as well as exterior surfaces. Allow excess soap to drain off the equipment when finished.

5. Rinse the equipment with tap water in the second basin.

6. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.

7. Spray down the equipment in the third basin, using deionized water.

8. Spray down the equipment in the fourth basin, using pesticide-grade methanol, if sampling for organic compounds is to be performed. If oily, a two-step process using methanol, followed by hexane should be used to remove both water soluble and non-soluble compounds. If no organic compounds sampling is being performed, this step may be omitted.

9. Allow the equipment to completely air dry on clean polyethylene sheeting.

10. Rinse the equipment in the fifth basin, using deionized water.

11. Allow the equipment to completely air dry on clean polyethylene sheeting.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Re-use of equipment on the same day without wrapping in foil is acceptable.

13. Allow spent cleaning solutions in the trays to evaporate into the air. If evaporation is not possible, all spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation.

14. Record the decontamination procedure in the field logbook or appropriate field form.

15. If step 8, rinsing with organic solvents, was performed, check the equipment for the presence of residual solvents with a photoionization or flame ionization detector prior to use. If a detection occurs, disassemble the equipment and allow to air dry until no readings are observed. Re-rinse with deionized water.

16. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

17. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field log. In this case, additional rinses with deionized water should be used and recorded.

2.4 Procedure for Oversized Equipment

Oversized equipment, such as submersible pumps, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean barrels with tap water.

3. Add sufficient concentrated soap to one barrel to form a thin layer of soap suds.

4. Immerse the pump in the soap containing barrel and start pump. Circulate the soap solution through the pump and feed discharge into a waste disposal drum.

5. Immerse the pump in the barrel filled with clean tap water and start pump. Circulate the water through the pump and feed discharge into a waste disposal drum. Run the pump until no soap residue is visible in the discharge.

6. Deionized water should then be run through the pump and used to rinse all submersible parts and hoses.

7. Record the decontamination procedure in the field logbook or appropriate field form.

8. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

9. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

2.5 Procedure for Measuring Equipment

Measuring equipment, such as pressure transducers or water level indicators, will be cleaned using the following procedure.

1. All equipment being removed from the Exclusion Zone shall be checked by the HPT. If the HPT determines that a piece of equipment is radiologically contaminated, it shall be decontaminated by the users under the direction of the HPT. The procedures described below may be sufficient to remove radiological contamination. However, use of abrasive materials, ultrasonic cleaners, or other methods approved by the HPT may also be required.

2. Fill two clean basins with tap water.

3. Add sufficient concentrated soap to one basin to form a thin layer of soap suds.

4. Immerse the device in the soap containing basin and gently agitate. Scrub device if it is soiled. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with potentially contaminated water.

5. Immerse the device in the basin containing the rinse water and gently agitate. Do not submerse any electrical connectors or take up reels, only that portion of the device in contact with contaminated water.

6. Spray rinse equipment with deionized water.

7. Allow the equipment to air dry.

8. Record the decontamination procedure in the field logbook or appropriate field form.

9. If equipment that was found to have radiological contamination upon leaving the Exclusion Zone is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Attachment 1).

10. If the equipment cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material. The equipment shall be kept in the Exclusion Zone or containerized for subsequent disposal with other radiological wastes.

ATTACHMENT 1

CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT:			TIME OF INCIDENT:		
NAME:			BADGE NO.		
LOCATION OF INCIDENT (SPECIFIC AREA)					
DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE				
CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS		FINAL DISPOSITION OF ARTICLES
			BEFORE	AFTER	
WOUND COUNT /5 MIN		BKGD COUNT /5 MIN		SOURCE COUNT /5 MIN	
	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO			IF NO, EXPLAIN	
SAFETY MEASURES					
REMARKS					
EMPLOYEE SIGNATURE			HEALTH PHYSICS SIGNATURE		

STANDARD OPERATING PROCEDURE NO. 100

WATER LEVEL MEASUREMENT PROCEDURES

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____Date: _____

SOP No. 100

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STANDARD OPERATING PROCEDURE NO. 100

WATER LEVEL MEASUREMENT PROCEDURES

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for conducting water level measurements in monitoring wells during field investigations at hazardous and non-hazardous waste sites.

1.1 Objective

The objective of water level measurements is to gain accurate measurements (to within 0.01 ft) of the depth of ground water for use during well installation, in the recording of data for the preparation of ground water elevation contour maps, purge volume calculations during ground water sampling, slug tests, packer tests, and pump tests.

1.2 Equipment

The following list of equipment may be utilized during water level measurements. Site-specific conditions may warrant the use of additional or deletion of items from this list.

- Electronic water level indicators – graduated
- Tap Water
- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap
- Deionized Water
- Pump Sprayer
- Pint Squeeze bottles
- Any necessary personal protective equipment (gloves, eyewear, tyvek suits)
- Air Monitoring instruments as required (HNu, OVM, etc.)
- Field logbook and monitoring form
- Well keys
- Previous measurement data (if available)
- Oil/water interface probe
- Plunker on tape

2.0 PROCEDURES

The following procedures should be followed during water level measurements. Procedures may vary depending on the equipment used and contaminants present at the site.

Site specific conditions may warrant the use of stringent air monitoring and potentially more significant decontamination scenarios.

1. Record the condition of the well (protective casing, concrete collar, lock in place etc.).

2. Check that the water level tape has no obvious kinks or damage.

3. Put on latex or other sterile gloves. Stand upwind of the well; unlock and open the well. If a vented cap is present, conduct well mouth air monitoring from the vent. If a non-vented well cap is present, remove the cap and monitor the well mouth immediately. Record all pertinent air monitoring results (sustained, dissipating, background, odor).

4. Identify the previous measuring point marking or notch on the riser or casing (if present). Record this location in the field logbook or on the water level monitoring form.

5. Using a previously decontaminated water level indicator, turn on the meter, check the audible indicator, reel the electronic probe into the well riser (with the increments visible) slowly until the meter sounds, grasp the tape with hand, withdraw the tape and lower it again slowly until the sound is again audible. Check the depth to water on the tape and make a mental note of the depth to within .01 feet. Lower the probe again slowly and repeat the measurement for accuracy. A one-foot error is the most common measurement type during water level measurements. Be sure to read the depth correctly on the tape.

6. Record the depth to water from the measuring point in the field logbook or on the water level monitoring form.

7. Procedures utilized during water level measurements where free phase petroleum products are floating on the water table should be modified to include the use of the oil/water interface probe. The procedures during the use of this probe should be implemented similarly and by manufacturers' specifications. Through the use of this probe, product thickness can be determined.

8. Decontaminate the probe and any obviously soiled tape. Refer to SOP 4 equipment decontamination.

Water Level Measurement Field Form

Site ____________________
Project Number ____________________
Date ____________________
Weather ____________________
Initials ____________________

Page _________ of _________

Well ID	Status	Location		Completion Data						Control Point		Measurement	
		Northing	Easting	Type	Construction	Drilling Date	Total Depth (ft bgs)	Screen Interval (feet)	Geologic Unit	Monitoring Point	Monitoring Point Elevation	DTW feet	Water Elev feet (calculated)

Notes

STANDARD OPERATING PROCEDURES NO. 110

GROUNDWATER SAMPLING USING THE LOW-FLOW PROTOCOL

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____

Approved by: _____ Date: _____

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STANDARD OPERATING PROCEDURE 110

GROUNDWATER SAMPLING USING THE LOW-FLOW PROTOCOL

1.0 INTRODUCTION

This standard operating procedure provides instructions for groundwater sampling using the EPA low-flow/minimal drawdown well purging protocol. Included in this standard operating procedure are field forms for sampling, instructions and forms for meter calibration, and directions for decontamination and documentation.

1.1 Equipment and Supplies

Pumps and probes may differ depending on the well diameter, groundwater constituents and depth to groundwater, but generally, sampling will require the following equipment:

- Peristaltic, bladder or Waterra pump capable of a flow rate between 50 and 500 ml/minute and appropriate power supply. The pump type will principally depend on the depth to water and well diameter. Bladder pumps are preferred; peristaltic pumps are acceptable only for wells where the depth to water is less than about 25 feet; Waterra pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump.
- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), dissolved oxygen and oxidation-reduction potential of groundwater, and a turbidity meter.
- Calibration solutions for the field probes
- Water level tape
- Tubing, connections and tools as appropriate
- Graduated cylinder and stopwatch
- 5-gallon bucket and funnel for purge water
- Field forms, notebook and PPE (as specified in the Health and Safety Plan)
- Decontamination supplies (e.g., DI water, Alconox soap, alcohol, paper towels)
- Sample containers and cooler (typically provided by the laboratory)
- Clean plastic sheeting, paper towels and miscellaneous supplies

2.0 PROCEDURES

2.1 Pre-Mobilization Activities

- Obtain the construction, diameter, depth, material, screened interval and map showing location for each monitoring well or multi-point sampler to be sampled.

- Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, sample volume, and holding time for each parameter. The parameters that will be measured in the field are the low flow stabilization parameters including temperature, pH, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity. These parameters will be recorded as required during low flow sampling, and immediately prior to collection of samples for laboratory analysis.

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. These steps ensure that instruments are functioning and properly calibrated, and that the necessary equipment has been supplied for efficient and accurate sampling.

Inventory

Verify that the correct equipment is ready to be shipped to the field site, and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required. Pre-labeled and bundled sample containers for each well (and depth at each well, and/or filtered versus non-filtered samples) to avoid confusion during sample collection.

Verify that the appropriate personal protective equipment and ancillary supplies (e.g., paper towels, decontamination solution) are ready to be shipped to the field site. The appropriate protective equipment, as specified in the site specific Health and Safety Plan, will be reviewed during a morning tailgate meeting. Contact the field supervisor or project manager immediately if there are discrepancies.

Calibration

Calibrate the field probes consistent with the manufacturer's specifications and the following requirements before sampling and at the start of each field day:

1. the pH probe will be calibrated using three points (pH = 4, 7, 10) using fresh calibration solutions;
2. the dissolved oxygen (DO) meter will be calibrated to moist air (100% saturation) and to zero DO using a saturated sodium bisulfite solution; and
3. the redox potential (ORP) meter will be calibrated using Zobell 231 mV solution.
4. specific conductance will be calibrated

Record the calibration data on the field calibration record provided in this SOP. Periodic checks of the calibration shall be performed at least twice more during the field day, including a check at the end of the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on field calibration forms. Also check calibration if any readings are suspect.

Inspect the well for the presence of lock, cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in the flush mount.

2.3 Well Purging and Sampling

Sampling is performed in teams according to the health and safety protocol for the site. Sampling is performed using a five-step procedure that will be followed upon arrival at each well:

1. set-up;
2. purging;
3. measurement of field parameters and field testing;
4. sampling; and
5. clean-up and decontamination.

Detailed procedures for performing each of these steps are provided in the following subsections.

Set-up

All necessary equipment for purging, sampling and storage will be brought to the well before the well is opened. Equipment will be placed on a clean plastic sheet near the well. General parameters describing the well and field condition (e.g., well ID, depth, weather, date and time) will be documented on a field data sheet. Sampling begins by opening the well and measuring the depth to the water surface, if possible (this may not possible for the multiport wells). The tubing, field probe, and reservoir for purged water are then set up.

Purging (Low Flow Protocol)

Wells are purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging are as follows.

- Lower the pump slowly down the well positioning the well intake at the middle of the well screen.
- Minimize disturbance of the water column in the well by initiating pumping at a low rate (see below). Dedicated tubing (left in-place between sampling events) is also recommended to minimize disturbance to the water column before and during sampling.
- Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes) to ensure that less than 0.1 ft of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 ft, but the pumping rate will not exceed 500 mL/min. In some silty and/or clayey formations, drawdown may exceed 0.1 ft when pumping at 100 mL/min. If this occurs, refer to the sections on *Variations from Low Flow Protocol* for alternatives to the low flow/minimum drawdown protocol.
- Field parameters and depth to water will be recorded on field data sheets a minimum of every 5 minutes while purging. Purging will continue until pH, temperature, specific conductance, ORP, DO concentration, and turbidity stabilize, which is defined as follows:
    - ±0.1 units for pH
    - ±3% for specific conductance
    - ±10 mV for ORP
    - ±10% for temperature
    - ±10% for turbidity and dissolved oxygen.

  Dissolved oxygen and turbidity tend to stabilize last and are better measures of sufficient purging. Drawdown should not exceed 0.1 ft during purging or sampling.

- In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are taken. If, at any time during this additional purging the stabilization criteria are met for three consecutive data logging events, then samples are taken at that point.

Variations from Low Flow Protocol

Wells in low yield formations such as poorly fractured bedrock and silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) without more than 0.1 ft of drawdown. In these cases, a modified low flow method will be used, the choice of which will be made by the Project Manager based on site conditions. Currently, there is no published protocol for sampling low recharge wells. Two modifications described below have been endorsed at one site by the EPA for sampling and purging wells that yield less than 100 mL/min at a drawdown of 0.1 ft.

Alternative Method 1: less than half the casing volume is located above the well screen

Purge the well with the pump intake located at the mid point of the well screen by constant pumping at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. Measure and record the field parameters and water depth at a minimum of 5-minute intervals or at the end of every purge cycle, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity). Cease pumping until the water level in the well equilibrates to static conditions. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Alternative Method 2: more than half the casing volume is located above the well screen.

The well will be purged with the pump intake located at midscreen at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. This will remove at least one-half of a casing volume of water from the well. The well is then allowed 8 hours to recover, after which time a volume of water equal to the casing volume of the screened interval will be removed, removing approximately a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is to be collected from the midpoint of the screened interval.

Other Modifications to Low Flow Sampling

Other modifications of the low-flow protocol may be required on a site-specific basis. Low-recharge wells screened across the water table are not amenable to either of the methods described above. It may not be practical to sample extremely low recharge wells using any of the cited modifications, which case, evacuate all casing water and re-sampled as soon as sufficient recharge has entered the well to provide a sample. Data from such wells will be qualified to indicate the potential for sample bias.

Field Measurements

Field parameter measurements will be recorded following parameter stabilization (purging) and before sampling. The pumping rate and sampler intake location in the well are not to be adjusted after purging. The field parameters measured are pH, temperature, specific conductance, DO, ORP, and turbidity.

Sampling

Samples will be collected after field parameters have stabilized and been recorded. The pump rate and sample intake location will not be adjusted between purging and sampling with the exception that the pump rate can be increased after the SVOC samples are taken. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). The following sampling strategy is to be followed at each location in its entirety prior to beginning a new location.

Sampling for VOC and Biodegradation Parameters

Sample containers are to be filled in the order listed below and on the field data sheet using the following protocols:

1. VOC samples will be collected first. Prior to filling the three 40 ml VOA vials that will go to the laboratory, a fourth "dummy" vial will be filled and checked with pH paper to make sure that the pH of the sample is <2. In the case that further pH modification is necessary, the number of drops of HCl required to lower the pH below 2 will be recorded. This number of drops of HCl will be added to the other three VOA vials prior to filling them with the groundwater sample. Sample containers are to be completely filled so that a meniscus forms over the opening of the container. The container lid will be moistened with groundwater and screwed to the container body. The container is then turned upside down and inspected for air bubbles. If air bubbles exist in the container, then it is "topped off" to eliminate bubbles. This procedure is repeated until there are no entrapped bubbles in the container. Water miscible solvents will be collected next in three 40 ml amber glass VOA vials without preservative. Filled samples are stored at 4°C (±2°C).
2. Biodegradation-related parameters will be sampled next. Biodegradation-related parameters are to be sampled in the following order and with the following procedure:
    a) Dissolved Gases (methane, ethane, ethene) – water will be dispensed into two 40 ml bottles with HCl as a preservative to achieve a pH below 2, sealed without a headspace, and stored at 4°C (±2°C). Collect a "dummy vial" as described above with the acid preservative listed within this sub-section.

    b) Ferrous Iron – water will be dispensed unfiltered to a 500 ml amber glass bottle with HCl as a preservative to achieve a pH below 2, sealed and stored at 4°C (±2°C). Note: use of unfiltered samples requires a ferrous iron-specific method to be used, as colloidal ferric iron may be present in unfiltered samples and be detected by a total iron method. Collect a "dummy vial" as described above with the acid preservative listed within this sub-section.

    c) Major Anions (sulfate, nitrate, nitrite, and chloride) – water will be dispensed into two 500 ml plastic bottles, sealed and stored at 4°C (±2°C).

    d) Alkalinity – water will be dispensed into a 500 ml plastic bottle, sealed and stored at 4°C (±2°C).

    e) TDS – water will be dispensed into a 500 ml plastic bottle, sealed and stored at 4°C (±2°C).

f) Sulfide (with the exception of low yield wells where TDS and sulfide will be collected last) – water will be dispensed into a 500 ml glass bottle with an appropriate aliquot of NaOH added to raise the pH to >9 (pH paper directly in the sample bottle will be used to determine the endpoint). Twenty drops of zinc acetate are then added and the bottle is sealed without any headspace (air bubbles) and stored at 4°C (±2°C).

g) TOC – water will be dispensed into a 125 ml amber glass bottle with H_3PO_4 as a preservative to achieve a pH below 2, sealed and stored at 4°C (±2°C). Collect a "dummy vial" as described above with the acid preservative listed within this sub-section.

4. After all of the biodegradation related parameters are collected, the following samples are collected (note - the pump rate can be increased after the SVOC samples are collected):

   a) SVOC – water will be dispensed into two 1000 ml amber glass bottles without a preservative, sealed and stored at 4°C (±2°C).

   b) Total Phenol – water will be dispensed into a 1000 ml amber glass bottle with H_2SO_4 as a preservative to achieve a pH below 2, sealed and stored at 4°C (± 2°C).

   c) Pesticides - water will be dispensed into two 1000 ml amber glass bottles without a preservative, sealed and stored at 4°C (±2°C).

   d) Metals – groundwater will be split into two portions; one filtered sample and one unfiltered sample. The filtered sample (for dissolved metals analysis) will be field filtered using a clean, disposable, 0.45 µm filter attached in-line to the sample tubing. Filtered water will be dispensed into a 500 ml wide mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed and stored at 4°C (± 2°C). Unfiltered water (for total metals analysis) will be dispensed directly in to a 500 ml wide mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed and stored at 4°C (± 2°C).

Note that some samples require a preservative, which will be dispensed to the container by the laboratory prior to its being shipped to the Site. For those parameters that have a target pH specified, 'dummy vials' will be provided. The exceptions to this are Total Phenols and Metals. For these two parameters, pH paper inserted directly into the sample bottle will be used to verify that the target pH has been achieved. Are we certain that if we do this we are not compromising sample??? For the other parameters with a specified pH the 'dummy vials' will be filled with groundwater and checked with pH paper to determine if the target pH has been achieved. If not, additional HCl (or

appropriate acid preservative) will be added drop-wise until the correct pH is reached in the dummy vial. This additional amount of acid will be added to the sample vials prior to filling. The sulfide sample requires that zinc acetate be added drop-wise to the bottle after it is filled regardless of the sample pH to stabilize the dissolved sulfide. Care will be taken not to spill the preservative or overflow the container. Samples containing preservative cannot be emptied and refilled, so they must be collected without air bubbles on the first filling attempt or carefully topped off.

Observations During Sampling

Field sampling staff will identify and log any observations that may be considered *unusual* into a field notebook or on the field data sheet for each well. These observations include but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors such as sulfide; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; unusual sounds made by the equipment. In addition, sampling personnel will note the condition of the well upon arrival and inspection. If the well casing is damaged and there are anomalies in the calculated water level at the well, then the casing damage may indicate compromised sample quality.

Storage and Shipping

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C ($\pm$2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. The Chain of Custody forms for each sample suite will be sealed inside of a Ziploc® container (doubled if necessary) and placed in the cooler with the corresponding samples. Fragile material (glass or other breakable sample vials) is to be wrapped with bubble wrap or a similar material. Refer to the Standard Operating Procedure for sample shipping.

Clean-Up and Decontamination

Refer to the Standard Operating Procedure for equipment decontamination.

2.4 Documentation

Field documentation includes completed calibration records, low flow sampling data sheets, daily field logs and other field notes deemed relevant. It is essential that field data sheets be filled out completely and legibly at each location, and that entries are consistent for each location and among different personnel. As referenced above, low-flow data and calibration forms are provided with this SOP. The attached field sheets may be modified to represent the specific parameters of interest for a given project, but should include the following information:

- Job, site, date and sampler;
- Well identification and description;
- Reference elevation and depth to water;
- Casing volume calculation;
- Depth of pump intake during purging and sampling;
- check list of items for pre-sampling well condition inspection;
- Equipment used (field probes, tubing, model and serial numbers);
- Purge rate, field parameters (temperature, conductivity, DO, ORP, pH, and, if specified, turbidity) and depth to water recorded every 5 minutes;
- Sampling parameters;
- Stabilized field parameters;
- Identification, time, container types, preservatives, and analytical methods for samples; and,
- Space for comments.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

QC Checks –check water level data against historic water levels for each well. Call project manager if water levels are not within historic range. Check sample parameters against analyte listing to make sure you got all the samples collected that you were supposed to BEFORE you leave the site.

QA/QC samples – collect field duplicates and MS/MSD as required by QAPP.

To ensure that all data collected is scientifically valid, defensible, and of known precision and accuracy, Quality Assurance and Quality Control (QA/QC) procedures, as outlined in the Quality Assurance Project Plan (QAPP), will be implemented. The groundwater sampling events may include the collection and analysis of appropriate types of QC samples. These samples may be submitted as “blind” duplicates to the laboratory, in which case it is essential that the field sampler record the location from which the blind sample(s) is taken.

METER CALIBRATION REPORT

GeoSyntec Consultants
289 Great Road, Suite 105
Acton, MA 01720
Phone: 978-263-9588, Fax: 978-263-9594

Project Name: _____ Date: _____ Page ____ of ____

Project Number: _____ Primary Activities: _____

Field Personnel: _____

_____

Recorded By: _____

Weather: _____

Initial Calibration Completed at: _____ (time)

Final Calibration Check Completed at: _____ (time)

pH calibration		buffer solution		
		pH 4.0	pH 7.0	pH 10.0
initial	temp. (°C)			
	instrument reading			
	should read/calibrated to			
final	temp. (°C)			
	instrument reading			

specific conductance calibration		standard (µS / cm)	
initial	instrument reading		
	should read/calibrated to		
final	instrument reading		

ORP calibration		Zobell solution (+231 mv Zobell reads)
initial	instrument reading	
final	instrument reading	

dissolved oxygen calibration		100%	0%
initial	temp. (°C)		
	instrument reading		
	should read/calibrated to		
final	temp. (°C)		
	instrument reading		

turbidity		
initial	instrument reading	
final	instrument reading	

Meter Summary
pH Meter / Probe: Model:
DO Meter / Probe: Model:
ORP Meter / Probe: Model:
Conductivity Meter / Probe: Model:
Turbidity

Comments: (rental, condition, problems)

ATTACHMENT A

BACKGROUND ON LOW-FLOW/MINIMAL DRAWDOWN PURGING

Monitoring Well Sampling

The objective of groundwater sampling is to obtain a sample that is representative of groundwater quality under ambient flow conditions. To achieve this objective, a representative groundwater sample should contain: (1) the average concentration of all chemical constituents present in the target aquifer volume; (2) constituents in the same phase and chemical speciation as present in-situ; and (3) only the chemical constituents that are mobile under ambient groundwater flow conditions. The purpose of this section is to describe sampling practices that are most appropriate for investigations and to discuss key issues relevant to sampling. This discussion relies in part on sampling guidance developed by the EPA.

Traditional methods of groundwater sampling call for purging 3 to 5 casing volumes of water from a well prior to sampling (Robbins and Martin-Hayden 1991, Barcelona et al. 1994, Wilson et al. 1995). These methods are no longer recommended by EPA because they can induce bias through sample disturbance and particle mobilization, and produce larger volumes of purge water that increase exposure potential and disposal costs. Currently, EPA recommends the low flow protocol for obtaining groundwater samples, although new sampling methods such as diffusion samplers are gaining regulatory acceptance in some situations. The low flow protocol and modifications to the low flow protocol that may be needed under some conditions are discussed in the following sections.

Note that although this document recommends low flow purging as the most widely accepted and reliable sampling method, modifications of the low flow protocol or other sampling protocols may be applicable in certain circumstances.

Low Flow Purging

The purpose of low flow purging is to draw sufficient water into the casing from the formation to produce a representative sample without generating excessive groundwater velocities outside the casing, which can bias the sample. Properly implemented in an appropriately constructed monitoring well, low flow purging induces lateral flow from the formation directly through the well screen and into the sampler intake. Several measurements that are often important for investigation and are particularly sensitive to sampling bias caused by high flow purging include concentrations of dissolved gasses (O_2, CO_2, methane, ethane) total metals, and ORP. An additional advantage of low flow purging is that mixing between water entering the casing and stagnant water existing in the casing is minimized, thus achieving

stabilization of the purging parameters described below with less extracted volume than conventional purging.

Low flow purging uses the same stabilization criteria as conventional purging (i.e., stable temperature, dissolved oxygen concentration, conductivity, Eh, pH, and turbidity), but requires careful flow regulation (typically at a rate of 0.1 to 0.5 L/min) to limit drawdown to the extent practical (less than 0.1 ft is the goal). Since low flow purging requires steady removal of water with minimal disturbance, grab samplers (e.g., bailers) cannot be used with the low flow protocol and are not recommended for either purging or sampling. According to Puls and Barcelona (1996), a representative sample can be collected when three successive measurements (taken at 5 minute intervals) are within ±0.1 units for pH, ±3% for conductivity, ±10 mV for E_h, and ±10% for turbidity and dissolved oxygen. The low flow sampling protocol provides for accurate measurement of in-situ values of these parameters (with the possible exception of temperature), which are important geochemical data for characterization. pH and temperature measurements tend to stabilize first, and are not particularly sensitive measures of complete purging, whereas dissolved oxygen and turbidity will stabilize last and are better measures of sufficient purging.

Puls and Barcelona (1996) have outlined the procedural requirements of low-flow purging as follows:

- The sampling device should be placed in the middle of the well screen to prevent the entrainment of solids from the bottom of the well into the sample (similar positioning for subsequent sampling rounds is critical for comparability of data).
- Minimize disturbance of the water column in the well by installing sampling equipment carefully or using equipment dedicated to each well, and initiating pumping at a low rate.
- Employ steady pumping at a rate that maintains less than 0.1 ft of drawdown. In most formations, this will correspond to a flow rate of 0.1 to 0.5 L/min, but may be less than 0.1 L/min in silts and clays or greater than 1 L/min in coarse sands and gravels or from large diameter wells. Sevee et al. (2000) provides design equations that can be used for estimating the pumping rate that yields 0.1 ft of drawdown, given well size and aquifer hydraulic conductivity.
- Purging should continue until pH, temperature, conductivity, E_h, dissolved oxygen concentration, and turbidity stabilize. These measurements should be made in a sealed, flow-through cell. Of these parameters, turbidity is the best parameter for measuring sufficient purging. Satisfactory purging may require removal of more than one casing-volume of water, but typically requires less than three casing volumes.

- A dedicated, pre-installed pump or tubing is recommended to minimize the time required to sample each well. Use of dedicated pumps also prevents cross contamination of wells that can result from incomplete decontamination and causes less mixing of casing water prior to purging. The cost-effectiveness of using dedicated pumps should be assessed based on site-specific sampling requirements.

Samples should be obtained from a sampling port upstream of the flow-through cell after parameter stabilization is achieved. Samples may be field-filtered if DQOs require measurement of dissolved versus mobile chemicals. Filtering should not be used to compensate for poor sampling technique, although in some cases the generation of turbidity artifacts may be unavoidable (e.g., fine-grained formation, poorly installed wells). When filtering is needed for either reason, in-line cartridge filters are recommended because they reduce handling and exposure of the sample to the atmosphere. If maintaining accurate particle-size cutoffs is a concern in filtering, a cascade system should be used (i.e., 1 micron pre-filter, followed by filtration through 0.45 micron or other smaller size filter).

In summary, the low flow protocol is preferred because it:

- Typically minimizes the volume of purge water for disposal;
- Provides most accurate measurements of volatile constituents;
- Ensures collection of samples representative of in-situ conditions;
- Collects samples containing only the mobile fraction of particulates; and
- Is less vulnerable to inconsistencies among sampling staff over time.

Low flow sampling also has several disadvantages that must be kept in mind when planning sampling programs:

- Higher initial capital costs, particularly if a pump is dedicated for each monitoring well;
- More time is often required to obtain a sample, which can increase total cost;
- More sophisticated equipment is used which requires more training; and
- More equipment needs to be transported to the field (e.g., conventional purging requires only a bailer whereas low-flow purging requires a pump, air cylinder, battery, or other power source).

Careful consideration of the appropriate sampling practice is critical to investigation. Traditional sampling techniques can provide inaccurate, misleading, or incomplete information relative to many aspects of geochemistry relevant for assessment. The importance of low flow sampling at sites is emphasized by Woodward (2000) who presents a case study that illustrates that many years of traditional sampling failed to support an argument that was later demonstrated relatively easily once low

flow sampling was used. In this case, traditional sampling methods indicated aerobic conditions not conducive to the degradation of the contaminants. Low-flow sampling techniques revealed that in-situ conditions were in fact anaerobic.

Modified Low Flow Protocol (low recharge wells)

Wells in low yield formations such as bedrock and clay may not be conducive to low flow purging and sampling. In these cases, pumping even at low rates may cause more than 0.1 ft of drawdown in the well or evacuate the well casing altogether. Note, however, that in these cases traditional purging is also inadequate, and it is even more important to remain cognizant of and strive to implement the goals of low flow sampling.

The practical lower limit on purge rate is a function of the casing volume, logistical constraints (time, available equipment, accessibility of the monitoring well), the required sample volume for analysis, and the tendency for sample quality to be altered as it passes through the sampling equipment. At very low pumping rates, the volume of the flow through cell must be decreased, and sample tubing length, thickness, and material may become critical. Barcelona et al. (1985) provide guidelines for tubing length, diameter, and thickness to minimize gas diffusion across tubing walls.

If, after consideration of these factors, it is determined that the low flow protocol is impractical, a modified low flow method should be used. Currently, there is no established protocol for sampling low recharge wells. The EPA low flow protocol has provided guidance for low flow sampling in low permeability units and several investigators have addressed the issue of bias in VOC measurements resulting from purging of low recharge rate wells. The low flow guidance and the findings of these studies are consistent with the following modifications to the low flow protocol. These modifications have recently been endorsed by the EPA for sampling and purging of wells that yield less than 100 mL/min at a drawdown of 0.1 m. During implementation of these methods, constant pumping with a peristaltic or bladder pump is recommended and field parameters should be measured, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity).

<u>Method 1</u>

The well is purged from the middle of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. Pumping is ceased and the water level in the well is allowed to recover to static conditions. The well is purged a second time at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen at which time pumping is ceased, this is repeated until a minimum of one casing volume is removed from the well. The well is allowed to recover sufficiently to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Method 2

This method is suggested for wells that have more than half of their casing volume of water located above the well screen. The well is purged from the middle of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. This removes at least one-half of a casing volume of water from the well. The well is then allowed 8 hours to recover, after which time a volume of water equal to the casing volume of the screened interval is removed, essentially resulting in the removal of a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is collected from the midpoint of the screened interval. If a modified low-flow protocol is required at a site, the choice of which protocol to implement should be made based on site conditions and regulatory preferences.

Other Modifications

Other modifications of the low-flow protocol may be deemed appropriate on a site-specific basis. Large diameter wells, for example, may require exceedingly long purge times at typical low-flow rates. Methods employed to sample such wells in a cost-effective manner should consider the potential to mobilize particulates, expose the sample to the atmosphere, obtain accurate field parameter measurements, and minimize waste.

References

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Robbins and Martin-Hayden. 1991. Mass Balance Evaluation of Monitoring Well Purging. *Journal of Cont. Hydro.* 8: 203-224.

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Sheet _____ of _____

Job No. _____ Date: _____ Initials _____

Site _____ Start Time: _____ Weather _____

Well ID Finish Time: Key No.

1. Well Water Level/Pump Information:

a. Well Diameter (in) _____ f. Initial depth to water from M.P. (ft) _____

b. M.P. Desc. (e.g., 2" PVC, notched) _____ g. Water column length [d-e+f](ft) _____

c. M.P. Elevation (ft) _____ h. Depth to top of screen (ft) _____

d. G.S. Elevation (ft) _____ i. Depth to pump intake (ft) _____

e. Depth of well from G.S. (ft) j. Saturated well volume (gal)

2. Field Water Quality Measurements

a. EquipmentDescription (type, model number, serial number)

Pump: _____

Meters _____

Flow through cell _____

b. Purging Information

Time:	Cumulative Purge Vol. (L)	Pump Rate (ml/min)	Temp (deg C)	Conductivty (m-ohm/cm)	Dis. Oxy. (mg/l)	Redox (mV)	pH	Turbidity (NTU)	Water Level (ft)

3. Sample Collection Information

Sample ID	Time Collected	Container Type/No./Vol.	Preservation	Analytical Method
1.				
2.				
3.				
4.				

notes: NA = not applicable NM = not measured/recorded

4. Comments:

METER CALIBRATION REPORT

GeoSyntec Consultants
289 Great Road, Suite 105
Acton, MA 01720
Phone: 978-263-9588, Fax: 978-263-9594

Project Name: _____ Date: _____ Page ____ of ____

Project Number: _____ Primary Activities: _____

Field Personnel: _____

Recorded By: _____

Weather: _____

Initial Calibration Completed at: _____ (time)

Final Calibration Check Completed at: _____ (time)

pH calibration		buffer solution		
		pH 4.0	pH 7.0	pH 10.0
initial	temp. (°C)			
	instrument reading			
	should read/calibrated to			
final	temp. (°C)			
	instrument reading			

specific conductance calibration		standard (µS / cm)	
initial	instrument reading		
	should read/calibrated to		
final	instrument reading		

ORP calibration		Zobell solution (+231 mv Zobell reads)
initial	instrument reading	
final	instrument reading	

dissolved oxygen calibration		100%	0%
initial	temp. (°C)		
	instrument reading		
	should read/calibrated to		
final	temp. (°C)		
	instrument reading		

turbidity		
initial	instrument reading	
final	instrument reading	

Meter Summary
pH Meter / Probe: Model:
DO Meter / Probe: Model:
ORP Meter / Probe: Model:
Conductivity Meter / Probe: Model:
Turbidity

Comments: (rental, condition, problems)

STANDARD OPERATING PROCEDURE NO. 120

CONSTRUCTION OF MONITORING WELLS

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

SOP No. 120

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STANDARD OPERATING PROCEDURE NO. 120

CONSTRUCTION OF MONITORING WELLS

1.0 INTRODUCTION

1.1 Objective

This standard operating procedure describes the protocol to be followed during the installation of monitoring wells, groundwater extraction and vapor extraction wells and piezometers. Drilling and logging of soil borings for the well installation will be in conformance with the standard operating procedures for the drilling and sampling of soil borings. The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or a health and safety plan. As the work progresses and if warranted, appropriate revisions to this standard operating procedure may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

1.2 Equipment

The field engineer/geologist overseeing the construction of the monitoring well should have the following equipment in the field during well installation:

- Field note book, pens and/or data sheets (see attached)
- Weighted Measuring Device
- Water Level Tape
- Level or Plumb Bob
- Calculator
- Well specifications for screened interval, filter pack length and construction, pipe diameter and type, etc. (provided in the field work plan)
- Appropriate personal protective equipment

2.0 PROCEDURES

2.1 Monitoring Well Installation

A *Daily Field Record* must be completed for each day of fieldwork, and the original will be kept in the project files. If required, permits will be acquired from the appropriate agency(s), and an underground utility check will be performed before drilling begins. An underground utility check will, at a minimum, consist of contacting local utility alert services, if available.

The field engineer/geologist shall inventory the well construction materials prior to be start of well construction. If sufficient materials are not on-site and/or in unacceptable condition, well construction will not begin until all appropriate materials are on-site. All proposed monitoring wells will be constructed from materials specified in the field work plan (e.g., two-inch diameter, Schedule-40 polyvinyl chloride (PVC)). All well materials shall be new and clean. Soiled materials will be cleaned prior to use, and decontaminated if there is a potential that well materials contacted contaminated surfaces.

2.2 Well Screen and Casing

The well casing and screen will generally consist of threaded stainless steel or schedule 40 (minimum) polyvinyl chloride (PVC) pipe, although Teflon, polyethylene, steel and polypropylene pipe are occasionally used. The casing material shall be defined in the field work plan, however, the inside diameter of the casing should be large enough to permit unobstructed passage of an appropriate water-level probe and equipment for purging wells and water sample collection.

All well casings and screens will be joined through threaded connections equipped with seals, solvent welds are not suitable due to the potential for contamination from the solvent glue.

The well screen will generally consist of machine-slotted PVC or wire-wrapped stainless steel screen. The screened sections will provide flow between the target zone and the well, allowing efficient well development and representative sample collection. Prior to the installation of the screen the project geologist or engineer will determine the proper screen slot size.

2.3 Filter Material

Filter material will be well-graded, clean sand (generally less than 2 percent by weight passing a No.200 sieve and less than 5 percent by weight of calcareous material). The filter material will be either a standard sand gradation designed for a range of anticipated soil types or a sand gradation specifically designed to fit the soils collected from anticipated well completion zone. The material specification for the filter pack will be specified in the field work plan.

2.4 Setting Screens and Riser Casing

Upon completion of drilling and/or geophysical logging, the boring will be sounded with a weighted measuring tape to verify the total depth of the boring. Approximately six-inches of filter pack sand shall be poured into the boring and allowed to fall to the bottom of the boring. The boring shall be sounded after placing the sand to verify its thickness.

The well casing and well screen will then be assembled ex-situ and lowered into the boring. If the boring is too deep to assemble ex-situ and lowered into the boring, it may be assembled in manageable lengths and each length attached as the well casing and screen are lowered into the boring. If the well casing and screen are assembled as they are lowered into the boring, extreme caution must be used to ensure materials (including the well casing and screen) do not accidentally fall down the well.

Well casing materials will be measured to the nearest 0.1 foot and steam cleaned before being used for well construction (materials in protective packaging do not require steam cleaning unless exposed to dirty or contaminated surfaces prior to installation). The bottom of the well will be fitted with a secure bottom-end cap. No PVC cement or other solvents will be used to fasten the well casing joints, well screen joints, or end caps.

Stainless steel centralizers shall be used for all sections of well in bedrock. Centralizers will be used immediately above and below the well screen and every 30 to 50 feet along the length of the casing. Centralizers need not be placed on well assemblies installed within augers or drill casings because the auger or drill casing will adequately center the well casing and screen in the borehole.

For borings drilled by the mud rotary method, potable water may be added to the drill mud and circulated in the borehole after completing the boring. Circulation will continue until the suspended sediment in the return fluid decreases. If borehole conditions are relatively stable, the mud will be thinned before the casing assembly is

lowered into the specified depth. This is preferred because it reduces the potential for clogging the well screen with thick mud. Conversely, if borehole conditions are relatively unstable, the mud will be thinned after the casing is placed at the specified depth but prior to installing the annular fill materials. After installing the well assembly, a slurry of filter sand and potable water will then be placed into the annular space.

For borings drilled using the hollow stem auger method, the filter sand will be placed after the well assembly has been lowered to the specified depth through the augers. The augers will be incrementally raised as the filter sand is placed by free fall through the augers. Increments of one to two feet are recommended. The depth to the top of the filter pack will be measured after each increment to detect possible bridging (bridging is the interlocking of sand particles between the well and boring which results in a void in the well annulus). If bridging occurs, it will be broken by washing the filter materials into proper place with potable water, by repeatedly raising and lowering the augers slightly, or by tapping the bridge with a steel rod. The amount of water, if any, added to the borehole must be noted on the *Boring Log* or in the *Daily Field Record*.

For monitoring wells, the filter sand will be placed in a calculated quantity sufficient to fill the annular space to a level of approximately 2 feet above the top of the well screen (the length of the filter pack will be defined in the field work plan). For extraction or pumping wells, the level of filter sand above the well screen will be based on site conditions. The depth to the top of the filter pack will be verified by measuring, using a weighted tape. Groundwater extraction wells or monitoring wells may be surged before placement of the transition seal to promote filter material settlement, as specified by the project manager.

Once the depth to the top of the filter material has been verified, bentonite or fine sand (choker sand) may be placed in the annular space as a transition seal between the filter material and the grout. A sufficient quantity of bentonite or fine sand will be poured to fill the annular space to a level of approximately 5 feet above the top of the filter pack. If bentonite is to be placed below standing water, a high-solids bentonite grout will be pumped through a tremie pipe, or bentonite chips may be poured through the annulus (bentonite pellets may be used in place of chips only if it is certain that the coating on pellets will have no impact on groundwater or aquifer chemistry). If bentonite is to be placed above standing water, a high-solids bentonite grout should be used or bentonite chips may be placed in 6 inch lifts. Unless prohibited by well conditions, each lift should be hydrated using approximately 1 gallon of potable water per lift or bentonite chips. The completed bentonite transition seal will be allowed to hydrate for at least 30 minutes prior to placing the grout. If a layer of fine sand is placed as the transition seal,

the fine sand will be mixed with potable water and placed as a slurry through the tremie pipe or poured dry through the annulus. The depth to the top of the transition seal will be verified by measuring, using a weighted tape.

A neat cement grout, cement/bentonite grout, or high-solids bentonite grout will be placed from the top of the transition seal to the ground surface. The grout seal will be placed in mud rotary borings. The grout seal will be placed in hollow stem auger borings by free fall through the augers as they are incrementally raised, or by pumping through flexible hose or tremie pipe lowered to near the bottom of the zone being grouted. The grout must be tremied if there is standing water in the augers above the transition seal. Grout/additive/water mixtures will be determined on a site-specific basis and specified in the field work plan. Typical specifications of grout mixtures include:

Neat cement grout shall be composed of Class A, Type I Portland Cement mixed with not more than seven (7) gallons of clean water per bag (one cubic foot or 94 pounds) of cement with a density of 15 to 16 pounds per gallon, or to manufacturer's specifications.

Bentonite-cement grout shall be composed of powdered bentonite (less than 5% by weight) mixed at not more than 8 gallons of water to the bag, with a density of 14 to 15 pounds per gallon, or to manufacturer's specifications.

High solids sodium bentonite grout shall have a minimum of 20% solids and be mixed per manufacturer's specifications with water and/or other required additives.

2.5 Surface Completion

Upon completion of the well, the riser pipe will be cut cleanly so that the top of the well is level, and a mark or notch made on the top of the riser pipe identifying a measuring point for all water level measurements at the well. The well will then be fitted with a suitable slip-on cap, threaded end cap, or waterproof cap will be fitted on the top of the riser casing to reduce the potential for entry of surface runoff or foreign matter. Either a steel protective well cover (e.g.,stovepipe), or a vault (e.g., roadbox) that may have a traffic-rated cover will be completed at the ground surface. All wells will be locked for security and will be designed to limit surface water infiltration. Protective well casing and vaults shall be sufficiently large for the well cap and lock, and shall be fixed in place using cement, concrete or a similar material.

2.6 Documentation

A well construction diagram for each well will be completed in the field on the *Well Log* by the field geologist/engineer and submitted to the reviewing geologist or engineer upon completion of each well. Well installation and construction data will be summarized in the *Daily Field Record* or on a specialized form produced for this purpose. Well development notes and field measurements of water quality parameters will be summarized on a *Well Sampling* and/or *Development Record*. Following review by the project manager, the original records will be kept in the project file.

2.7 Cleaning of Drilling Equipment

Cleaning the drill rig and associated drill equipment will follow the procedures discussed in the Equipment Cleaning standard operating procedure.

Decontamination fluid will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

3.0 SURVEYING

Following installation, the location, ground surface elevation, and measuring point elevation of each monitoring well will be surveyed. The locations will be surveyed relative to the Illinois East State Plane Coordinate System 1983. The ground surface and measuring point elevations will be surveyed relative to the National Geodetic Vertical Datum (NGVD) 1929. The measuring point will be the mark on the top of the PVC well casing.

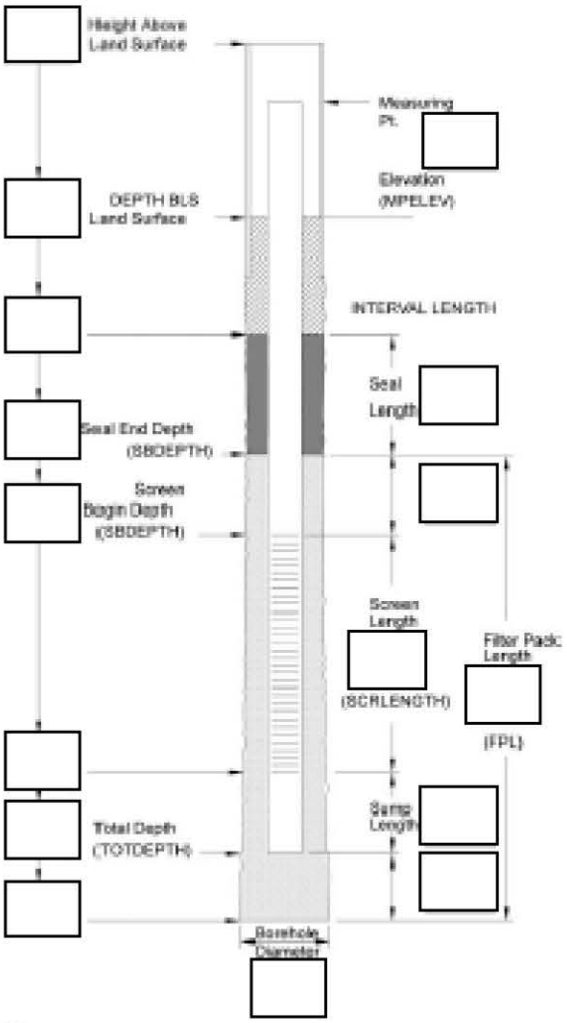
PROJECT #

FORM C
Fieldbook _____

WELL CONSTRUCTION LOG
ABOVE GROUND COMPLETION

Well I.D. (LOCID): _____
Drilling Company: _____
Driller: _____
Geologist/Engineer: _____
Signature: _____

Site: _____
Installation Method: _____
Casing Installation Date (INSDATE): _____
Well Type (WTCODE): _____
Well Completion Method (WCMCODE): _____
Geologic Completion Zone (GZCODE): _____



Comments
_____
_____
_____

Well Completion
Guard Posts (Y / N) Date: _____
Surface Pad Size: _____ ft x _____ ft
Protective Casing or Cover
Diameter/Type: _____
Depth BGS: _____ Weep Hole (Y / N)
Grout
Composition/Proportions: _____
_____
Placement Method: _____
_____
Seal Date: _____
Type: _____
Source: _____
Set-up/Hydration Time: _____
Placement Method: _____
Vol. Fluid Added: _____
Filter Pack
Type: _____
Source: _____
Amount Used: _____
Placement Method: _____
Well Riser Pipe
Casing Material (CMACODE): _____
Casing Inside Diameters (CASDIAM): _____ in.
Screen
Material: _____
Inside Diameter (SCRDIAM): _____ in.
Screen Slot Size: (SOUA): _____ in.
Percent Open Area (PCTOPEN): _____
Sump or Bottom Cap (Y / N)
Type/Length: _____
Backfill Plug (Y / N)
Material: _____
Placement Method: _____
Set-up/Hydration Time: _____
Total Water Volume During Construction
Introduced (Gal): _____ Recovered (Gal): _____
Reviewed
By: _____ Date: _____

STANDARD OPERATING PROCEDURE NO. 130

MONITORING WELL DEVELOPMENT

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

SOP NO. 130

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STANDARD OPERATING PROCEDURE NO. 130

MONTORING WELL DEVELOPMENT

1.0 INTRODUCTION

This standard operating procedure describes the protocol to be followed during the development of monitoring wells. As the work progresses and if warranted, appropriate revisions to this standard operating procedure may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

1.1 Objective

The objectives of monitoring well development are to remove sediment that may have accumulated during well installation, to consolidate the filter pack around the well screen, and to enhance the hydraulic connection between the target zone and the well.

1.2 Equipment

The following equipment may be used during well development. Site-specific conditions may warrant addition or deletion of items from this list.

- Submersible pump, peristaltic pump, and/or bailer;
- Surge block;
- Container for purge water (drums or fractionation tank);
- Container with known volume (e.g., 5-gallon bucket) for flow estimation;
- Water level indicator;
- Stopwatch or timer;
- Clear glass jars (at least 2);
- Well development record;
- Field notebook; and
- Pens.

2.0 PROCEDURES

2.1 General

Monitoring well development shall be performed, as soon as practical, after well installation but not sooner than 48 hours following placement of the grout seal. Weather conditions may increase grout set time and, consequently, further delay development.

Development of wells shall be accomplished with a submersible pump, peristaltic pump, and/or bailer that shall preferably remain solely dedicated to that well. Bailers shall be used to develop wells only where the volume of water is so small that other development methods are clearly inappropriate. Pumps used for well development shall be periodically raised and allowed to drain back into the hole in order to induce flow out through the well screen.

A surge block may be used to flush the filter pack of fine sediment in instances where field personnel expect that development may be improved by surging. Surging will be conducted slowly to reduce disruption to the filter pack and screen. Following surging, the well will be pumped or bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced to acceptable levels (see below). Water shall not be added to the well to aid in development.

Small-diameter wells shall be developed with an inertial pump to remove silt and fine sand that enter through screen slots immediately following well installation. Pumping shall continue from the screened interval until a volume of water equal to or greater than three saturated well volumes has been purged.

A well is considered fully developed when all the following criteria are met:

- the well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar);
- the sediment thickness remaining in the well is less than one percent of the screen length; and
- the total volume of water removed from the well equals five times the standing water volume in the well (including the well screen and casing plus saturated annulus, assuming 30 percent porosity) plus the volume of drilling fluid lost.

These criteria may be modified with approval by the field manager. Should the recharge to the well be so slow that the required volume cannot be removed in 2 to 3 consecutive hours, if the water remains discolored, or excess sediment remains after the five-volume

removal, the project team shall terminate purging and/or discuss other options for improving water quality.

The cap and all internal components of the well casing above the water table shall be rinsed with deionized water to remove all traces of soil, sediment, and cuttings. This washing shall be conducted before and/or during development.

2.2 Documentation

The following data shall be recorded for development:

- well designation;
- date of well installation;
- date of development;
- static water level before and after development;
- quantity of drilling fluid lost during drilling;
- quantity of standing water in well and annulus (30-percent porosity of saturated annulus assumed for calculation) prior to development;
- depth from top of well casing to bottom of well;
- screen length;
- depth from top of well casing to top of sediment inside well, before and after development;
- physical character of removed water, including changes during development in clarity, color, particulates, and odor;
- type and size/capacity of pump and/or bailer used;
- height of well casing above/below ground surface;
- typical pumping rate;
- estimate of recharge rate; and
- quantity of water removed and time for removal.

This information shall be documented on a Well Development Record (attached).

WELL DEVELOPMENT DATA FORM

Site Name: _____	Project Number: _____
Well Name: _____	Date Installed: _____
	Date Developed: _____
Depth To Bottom:	
(Initial) _____	Pump (Type) _____
(Final) _____	(Capacity) _____
Static Water Level:	
(Initial) _____	Bailer (Type) _____
(Final) _____	(Capacity) _____
Field Cleaning of Equip:	
Save Purge Water:	Purge Water Contaiment Method:
Measuring Point:	GeoSyntec Representative:
Casing I.D.:	Drilling Firm Representative:

Time	Volume of Water Removed	pH	Temp	Specific Conductance	Turbidity	Salinity	ORP	Comments

STANDARD OPERATING PROCEDURE NO. 140

WELL ABANDONMENT

Prepared by:_____ Date:_____

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 140

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STANDARD OPERATING PROCEDURE NO. 140
WELL ABANDONMENT

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) provides instructions on the proper method for decommissioning and abandoning wells. The methods provided in this SOP are designed to prevent contaminant migration from the ground surface to the water table or between separate aquifer systems.

This SOP will be implemented in accordance with the following governing documents:

- RI/FS Work Plan, which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RI/FS;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

The USEPA-preferred method of well abandonment requires the following steps:

1. remove well casing and screen;
2. clean out borehole;
3. backfill the cleaned bore hole with cement, bentonite grout, neat cement, or concrete; and

4. notify appropriate state agency.

1.2 Equipment

Well abandonment requires the services of a drilling subcontractor in most cases. The driller will provide the equipment need for well abandonment. A field geologist/engineer will oversee the well abandonment. The field engineer/geologist should have the following equipment:

- Personal Protective Equipment (PPE) and air monitoring equipment as specified by HASP;
- field log book;
- pen; and
- appropriate documentation (e.g., FSP, maps, HASP, and SOPs.

2. PROCEDURES

2.1 Removal of Well Screen and Casing

PPE will be donned and air monitoring begun per HASP requirements before drilling begins.

These procedures are appropriate for wells with diameters of one to four inches. This task may be accomplished by drilling over the well casing to the bottom of the borehole using a hollow stem auger. This will remove the well, grout and filter pack. A drill rig will be necessary to perform this task. The borehole shall then be cleaned by flushing with water or drilling mud. The cleaned borehole shall then be backfilled using a cement and/or bentonite grout placed using the tremie method. The top two ft of the borehole should be sealed with concrete to create a secure surface plug.

2.2 PVC Well Removal

Polyvinyl chloride (PVC) is soft enough to drill out using an auger or rotary bit, but can be difficult to remove because the PVC has a tendency to break during removal procedures. If PVC breaks when over-drilling using a hollow-stem auger, a mud rotary

or sonic drilling method should be used to remove the old well. Drilling directly down the well should be performed. A casing that is several inches larger than the well diameter and filter pack should be advanced. The well, well seal, and filter pack shall all be drilled through and removed as drill cuttings. After removal of casing materials, the well shall be flushed with drilling fluid (if using mud rotary) to remove all well cuttings, and then the boring should be tremie grouted (to within two-ft of the ground surface) and a two-foot concrete plug/surface seal should be installed. In some instances, surface protection may be specified.

2.3 Documentation

The following items will be documented in the field log book:

- monitoring well abandoned;
- drilling contractor;
- drilling method;
- any drilling irregularities (e.g., trouble removing well materials);
- abandonment materials; and
- start and end time.

STANDARD OPERATING PROCEDURE NO. 200

SURFACE SOIL SAMPLING

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

SOP No. 200

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STANDARD OPERATING PROCEDURE NO. 200

SURFACE SOIL SAMPLING

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the logistics, collection techniques, and documentation requirements for collecting surface soil samples.

1.1 Objective

The objective of surface soil sampling (soil samples between ground surface and 6-12" below ground surface) is to obtain a representative sample of soil for laboratory analysis of contaminants of concern at a given site. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.2 Equipment

The following equipment is needed for surface soil sampling:

- PPE AS SPECIFIED IN THE HASP.

- Sample containers - one (1) liter glass jar with a Teflon lined cap or two (2) 8 oz. glass jars with Teflon lined caps (per sample). Samples to be analyzed for VOCs will be collected by the USEPA 5035 method using the following glassware: (a) "high level" analysis – one (1) 40 ml VOA vial pre-preserved with 15 ml of methanol; or, (b) "low level" analysis – one (1) 40 ml VOA vial pre-preserved with 15 ml of methanol, and two (2) 40 ml VOA vials pre-preserved with 5 ml of sodium disulfate. All samples submitted for VOC analysis will include one small (40 ml to 4 oz) container, to allow the laboratory to record the moisture/dry-weight characteristics. Should conditions allow, VOC samples may be collected with Encore samplers, rather than methanol – preserved glassware.

- Samples collected for VOC analysis with the use of Encore samplers will be containerized as follows: (a) for high level VOC analysis, one 25-gram Encore sampler will be provided to the laboratory; and, if appropriate, (b) for low level VOC analysis, two 5-gram Encore samplers will be provided to the laboratory.

- Stainless steel spoon or spatula.

- Wooden stakes and spray paint (highly visible).
- Field logbook and/or Sample Log Form (Form AF-212).
- Sample bottle labels
- Chain-of-custody forms
- Hand auger
- Stainless steel trowel/shovel
- Stainless steel mixing bowl
- Disposable syringe
- Digital Scale (accurate to +/- grams)
- Encore sampling containers, if conditions allow
- Indelible marking pens

2.0 PROCEDURES

2.1 Sampling Procedure

The following procedure should be used for surface soil sampling.

1. All surface debris should be removed prior to sampling including wood, paper, sod, gravel, and trash. Identify the sample location and mark with a stake, flagging, or similar marker.
2. Collect the soil using a stainless steel shovel, hand auger, trowel and/or spatula. Avoid collection of larger pieces of material (cobbles, larger rocks). If a matted root zone is present at the sample location, it should be removed prior to sample collection.

3. A pre-cleaned stainless steel spoon or spatula should be used to take the soil sample and fill the sample containers except in the case of a sample for VOC analysis, which are collected using an open barrel disposable syringe. Care should be taken to avoid sampling anything but soil. Stones, gravel, or vegetation should be removed from the sample since these materials will not be analyzed.
4. For VOC analysis prior to collecting the sample, USEPA method 5035 specified preservative (5 ml sodium bisulfate for low level analysis and 15 ml methanol for high level analysis) will be added to sterilized 40 ml containers (Appendix A). Each pre-preserved container will then be weighed prior to sample collection, and the container/preservative weight will be recorded on the chain of custody. A digital scale capable of +/- 0.1 gram(s) accuracy will be used to weigh the sample containers in the field.
5. If a sample for VOC is desired it will be collected first using an open barrel, disposable syringe. VOC samples should **never** be homogenized or composited.
6. For a Low Level Analysis the soil will be extruded into a prepreserved VOA vial containing a stir bar, sodium bisulfate (5 ml) and distilled water.
7. If the sample is collected for high level volatile analysis, the sample will be extruded into a VOA vial containing “Purge and Trap” grade methanol (15 ml).
8. The syringe will be filled with undisturbed soil of the following approximate volumes: 5 grams of soil for low-level analysis (added to the soil of sodium bisulfate); and/or 15 grams of soil for high level analysis (added to the 15 ml of methanol).
9. Any particles of grains present on the container rim or cap will be removed to ensure an adequate seal of the vial. The VOA vial will be capped quickly and label with sample IDs, date, and time of collection. The container/preservative/sample will then be weighed and that post-collection weight will also be recorded on the chain of custody. The objective sample weights (5 g for low-level analysis, and 15 g for high level analysis) will be achieved (+/- 10%) with the use of the digital scale. Should insufficient sample volume be added to the preserved container, a stainless-steel spatula will be used to add a small portion of sample until the target weight is achieved (or exceeded within 10%).
10. In the event that a field screening technique (PID/FID instrument reading, visual staining of the soil, or olfactory observation) indicates the presence of VOCs or hydrocarbons, note the observations or instrument readings in the field logs.
11. Collect additional material for the remaining parameters by collecting the sample with the stainless steel spoon and transferring the soil into a stainless steel bowl. Homogenize the sample by mixing the sample within the bowl using the stainless steel spoon prior to filling the remaining sample containers.

12. Record the sample location, ID and time in the field logbook. Complete the Sample Log Sheet (attached) with the following:

    - Sample identification number
    - Sample location (sketch of the sample point)
    - Time and date sample was taken
    - Personnel performing the task
    - Visual description of the sample
    - Brief sediment descriptions (color, texture, appearance)
    - Weather conditions during sampling
    - Runoff conditions
    - Other pertinent observations
    - Soil description
    - Weights of preserved VOC containers before and after sample collection.

After the samples have been collected, the sampling location will be marked with wooden stakes colored with highly visible spray paint and labeled with the sample ID in order to survey the sample location.

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C ($\pm$2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. The Chain of Custody forms for each sample suite will be sealed inside of a Ziploc® container (doubled if necessary) and placed in the cooler with the corresponding samples. Fragile material (glass or other breakable sample vials) is to be wrapped with bubble wrap or a similar material. Refer to the Standard Operating Procedure for sample shipping.

Refer to Standard Operating Procedure 4 for equipment decontamination.

2.2 Duplicate Surface Soil Collection

The following procedures should be used for collecting duplicate surface soil samples:

1. For quality control purposes, each duplicate sample will be submitted to the laboratory as a "blind" duplicate sample, in that a non-existing sampling point will be assigned in labeling the duplicate. All labeling procedures used for surface soil sampling will be employed. Since the duplicate is collected simultaneously to the actual sample, a "blind" sample time, within one hour of the actual time, will also be assigned. The actual source and collection time of the duplicate sample will be recorded in the field book.

2. Each duplicate sample will be collected simultaneously with the actual sample. At the coincident step in the sampling procedures that the VOC containers are filled and sealed, the duplicate sample VOC containers will also be filled and sealed. Following the order of collection specified for each set of containers (VOCs, SVOCs, inorganic compounds) the duplicate sample containers would be filled simultaneously with each parameter.

3. All collection and preservation procedures outlined for surficial soil sampling will be followed for each duplicate sample.

STANDARD OPERATING PROCEDURE NO. 210

SOIL DESCRIPTION
VISUAL - MANUAL PROCEDURE OF THE
UNIFIED CLASSIFICATION SYSTEM

Prepared by:_____ Date:_____

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 210

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STANDARD OPERATING PROCEDURE NO. 210
SOIL DESCRIPTION
VISUAL - MANUAL PROCEDURE OF THE UNIFIED CLASSIFICATION SYSTEM

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the method for describing soil samples in test pits, soil borings, and soil grab samples. The SOP conforms to ASTM Standard D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and other pertinent technical publications.

This SOP will be implemented in accordance with the following governing documents:

- RI/FS Work Plan, which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RI/FS;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of soil sample description is to provide consistent geological information useful for the purpose of hydrogeological or geotechnical evaluation of a site. The Unified Soil Classification System (USCS) is the suggested classification method.

1.3 Equipment

The following equipment may be necessary during soil description activities:

- sand grading chart;
- field log book or forms as required by related SOPs;
- pocket knife, spoon, small spatula;
- folding ruler or yard stick;
- portable table;
- polyethylene sheeting;
- hand lens;
- deionized water in squeeze bottle;
- required personal protective equipment (gloves, boot, eye wear, hard hat, etc.);
- Personal Protective Equipment (PPE) and air monitoring equipment as required by HASP;
- duct tape; and
- boring logs (if applicable).

2. PROCEDURES

2.1 General

The general description of a soil sample should be in the following order:

1. color;
2. density;
3. moisture content;
4. geologic modifiers or classifications;
5. major constituent – capitalized;
6. minor constituent(s); and
7. geologic description (in parentheses).

Example: Tan, loose, wet, stratified, medium SAND, little fine sand, trace coarse sand, trace silt (Till).

Before beginning, ensure that PPE has been donned and air monitoring is being performed per the HASP. When logging a soil sample collected from a split spoon where more than one soil type is present, describe each one separately, using additional line(s) on the boring log form. Start the description from the top of the split spoon, and log each change in stratigraphy in sequence to the bottom of the spoon. Provide an interval or length (i.e., 0-0.5 ft.:) at the beginning of each separate sequence description, followed by a colon. Draw a line below the bottom of the complete sample description.

2.2 Color

The main color value should be stated, along with an appropriate modifier. Examples include: light brown, dark brown, reddish brown, and brown. The presence of mottling should be included in the description, where present.

Example: Gray, slightly mottled, dense, damp, poorly sorted angular fine to medium SAND, some silt, trace angular coarse sand, trace clay (lodgement glacial till).

2.3 Density

In borings, density should be based on the sum of the middle two 6-inch blow counts of a two-ft split spoon or the last two 6-inch blow counts of an 18-inch split spoon. Professional judgement should be used when applying the density modifier. If high blow counts are due to the presence of a cobble, boulder or large piece of gravel that impedes forward progress of the split spoon, density should based upon the character of the material in the split spoon, if any, or omitted from the description. A notation should be made in the sample description when this situation occurs. Appropriate modifiers are described in the following table.

Granular Soils		**Cohesive Soils**	
Blows/ft	**Density**	**Blows/ft**	**Density**
0-4	Very loose	<2	very soft
4-10	Loose	2-4	Soft
10-30	medium dense	4-8	medium stiff
30-50	Dense	8-15	Stiff
>50	Very dense	15-30	very stiff
		>30	Hard

In test pits, density is subjective and should be based upon the ease of excavation. The above adjectives for granular and cohesive soils should be used in the description.

2.4 Moisture Content

Moisture content should be described using the following modifiers:

- **dry** - no moisture;
- **damp**- very slight moisture content, no visible water droplets;
- **moist** - very slight moisture content, soils will not stick together;
- **wet** - enough moisture for soils to stick together; or
- **saturated** - water dripping from sample; soils below the water table.

2.5 Geologic Modifiers

Sedimentological descriptions aid in the geologic classification of a soil material. Only insert geologic modifiers when present.

Stratification: Note the presence and thickness of alternating layers of non-cohesive materials of different grain sizes and/or color with layers ***at least 6 mm*** thick.

Lamination or Varves: Note the presence and thickness of alternating very thin layers of fine materials or color, such as silt and clay, with layers ***less than 6 mm*** thick.

Sorting: A geological term used to describe how close in size the grains in a sample are to each other. For example, a well sorted sample contains grains of similar size; a poorly sorted sample contains grains of many sizes.

Angularity or Rounding: Geological terms that are used to describe the general appearance of visible grains in the soil sample. Useful in determining the origin and depositional environment of a material. Water transported materials may be rounded. Glacial tills will be more angular. The following terms describe differing degrees of angularity:

- **angular** – particles have sharp edges and relatively plane sides with unpolished surfaces;
- **subangular** – particles are similar to angular description but have rounded edges;
- **subrounded** – particles have nearly plane sides but have well-rounded corners and edges; and
- **rounded** – particles have smoothly curved sides and no edges.

Shape: A term used to describe the shape of gravel, cobbles, and boulders. Terms are as follows where the particle shape shall be described where the length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle:

- **flat** – particles with width/thickness > 3;

- **elongated –** particles with length/width > 3; or
- **flat and elongated –** particles meet criteria for both flat and elongated.

Odor: Describe the odor if organic or unusual. Soils containing a significant amount of organic material have a distinct odor of decaying vegetation. Always utilize appropriate breathing zone air monitoring equipment as specified in the site-specific HASP.

Cementation: Describe the cementation of intact coarse-grained soils as follows:

- **weak** – crumbles or breaks with handling or little finger pressure;
- **moderate** – crumbles or breaks with considerable finger pressure; or
- **strong** – will not crumble or break with finger pressure.

Identification of Peat: A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor. When present the sample shall be designated as highly organic soil.

2.6 Major/ Minor Constituents

Grain-size Scales: Grain size classification should be based on an accepted classification system, such as the Unified System. The predominate grain size should be listed in the soil description in all capital letters, selected from the following:

- boulder: 300 mm;
- cobble: 75 - 300 mm;
- coarse gravel: 19 - 75 mm;
- fine gravel: 4.75 - 19 mm;
- coarse sand: 2.0 - 4.75 mm;
- medium sand: 0.425 - 2.0 mm;
- fine sand: 0.075 - 0.425 mm;

- silt: 0.002 - 0.075 mm; or
- clay: <0.002 mm.

Proportions: For geologic description, proportions of grain sizes will be based upon the following nomenclature:

- trace: 0-10%;
- little: 10-20%;
- some: 20-35%; or
- and: 35-50%.

The major soil sample constituent is always capitalized and listed first. Minor constituents also include ancillary materials, such as mica flakes, dark minerals, or naturally occurring organic matter, such as humus, peat, or other vegetative material.

Geologic Description: Where possible based on existing site data, local research, or geologic understanding of the local region, include a geologic description of the sample. Examples include till, fluvial, glaciofluvial, fill material, or Lowell Formation. Do not utilize geologic description if not certain.

STANDARD OPERATING PROCEDURE NO. 230

SOIL AND ROCK BORING

Prepared by:_____ Date: _____

Reviewed by:_____ Date: _____

Approved by:_____ Date: _____

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STANDARD OPERATING PROCEDURE NO. 230

SOIL AND ROCK BORING

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for recording subsurface conditions in soil borings during site hydrogeological and geotechnical investigations. The SOP conforms to "A Compendium of Superfund Field Operations Methods (EPA/540/P-87/001)," and other pertinent technical publications.

1.1 Objective

The objective of soil and rock borings is to provide samples for description and characterization of subsurface conditions, and obtain samples for geotechnical and/or chemical analyses, often prior to installation of a monitoring well. This objective requires the use of consistent procedures for documenting observations and collecting samples.

2.0 PROCEDURES

2.1 Predrilling Requirements

When conducting borings in an industrial facility, the project or field engineer/geologist must contact all utilities or industrial facility personnel necessary to receive clearance to drill at specified locations. The names of the personnel authorizing clearance will be documented in the field logbook. The exact location of each boring shall also be reviewed by responsible plant personnel to ensure that the area is free of the facility-owned buried utilities.

Dig-safe must be contacted prior to drilling in public areas. Drilling locations shall be no closer than 25 feet to overhead utilities. The appropriate utility companies will be contacted to provide insulation of utility lines prior to commencement of drilling activities.

The supervising geologist/engineer shall record the name of the drilling firm and the names of the driller and his assistant(s). The date, project location, project number, and weather conditions shall be recorded as well.

An accurate time log of drilling activities shall be kept. This log shall be kept in the field logbook and shall include at a minimum, the following:

- Time driller and rig arrive on site
- Time drilling begins
- Any delays in the drilling activities and the cause of such delays
- Time drillers go off site
- Down time (those periods when drilling activities cease due to equipment malfunctions, weather, and ordered stoppages)

2.2 Test Boring Method

Test borings can be conducted by a variety of drilling methods. The more commonly employed test boring techniques may be classified in to six groups, based on the method used in displacing or removing subsurface material during the advancement of the borehole. The six drilling techniques are: displacement boring, wash boring, percussion drilling, rotary drilling, auger boring, and continuous sampling. The quality of the information obtained from the various boring methods varies greatly with the character of the subsurface geologic conditions, and careful consideration should be given in selecting the desired method. It may be necessary to employ more than one boring method to advance a particular borehole. The drilling techniques used on any particular project will be selected by the project manager and/or project geologist. In general, the wash rotary, and auger boring are most common and described below.

2.2.1 Wash Boring

This method involves advancing casing, as required, and washing-out the soil to the bottom of the casing with a chopping bit to the desired sampling depth. The casing can be advanced by either spinning or hammering (pounding) the casing with a 300-pound hammer. The borehole may be stabilized with the casing, water, or drilling mud, and open samplers, such as the split-or solid-spoon type are driven into the undisturbed soil at the bottom of the borehole.

This method is most commonly used in soils, which do not contain large cobbles and boulders, or cemented horizons. The wash boring method involves the introduction of drilling water and/or drilling mud to the borehole. The use of these materials and this method should be avoided whenever possible in conducting environmental investigations. The introduction of drilling fluids can alter the chemical composition of the groundwater adjacent to the borehole,

and may have an adverse effect on groundwater quality analyses on groundwater samples from monitoring wells installed in the completed borehole.

If it is necessary to use this technique to advance a borehole, the field geologist should determine the source and quality of the drilling water to be used in the boring process. The field geologist should not authorize the use of on-site or nearby groundwater or surface water bodies as the source of the drilling water, unless the proposed source has been sampled and analyzed for the full suite of contaminants considered likely to be present in the groundwater beneath the site. In all cases where drilling water or drilling mud are used to advance a borehole, the field geologist should consider obtaining a sample of the drilling fluid for potential analysis, at the discretion of the project manager and quality assurance/quality control (QA/QC) officer.

2.2.2 Rotary Drilling

This method is a variation of the wash boring technique, utilizing a rotary drill bit, rather than a chopping bit. It is employed primarily in advancing and cleaning the borehole to the required sampling depth, and is used in conjunction with air, water, or mud to bring the cuttings to the ground surface. This is the method generally preferred for exploratory test borings in the geo-technical consulting industry. This method is commonly used in environmental investigations when test borings are expected to encounter dense tills and coarse granular deposits (such as gravels), or are expected to terminate at depths exceeding thirty feet below the ground surface.

The primary disadvantage of this technique for environmental investigations is the introduction of drilling water or drilling mud. The use of air rotary drilling rigs is usually not appropriate for environmental investigations unless filters are used because the cuttings brought to the ground surface are ejected into the air adjacent to the drilling rig. Air born contaminated soil could pose a health risk to workers at the site and nearby residents.

2.2.3 Auger Borings

This method involves advancing helical solid-flight or hollow-stemmed augers, with large mobile equipment. This is a fast method for advancing the borehole, without the use of drilling fluid, and particularly effective for boring through partially saturated or unsaturated material above the groundwater table. Conventional sampling procedures are employed (split-spoon sampler). Some disturbance of the natural soil is caused by the advancing augers. Auger borings are primarily used for environmental investigations because they are cost effective and do not involve the introduction of drilling fluids and muds to the subsurface environment.

Auger borings are difficult to advance below the groundwater table in granular soils because the soils can liquefy and move up the auger stem and/or collapse against the auger flights and cause excessive friction. This condition is commonly referred to as "running sands" or "blowing sands" in the drilling industry. Running sands can be counteracted with limited success by maintaining a constant hydraulic head in hollow-stemmed augers during the sampling operations. However, the constant head technique is not very effective when drilling more than approximately ten feet below the water table in granular soils.

Augers are difficult, and sometimes impossible, to advance to depths of greater than thirty feet in dense tills or coarse granular deposits (such as gravel).

Solid stem augers are not recommended for environmental investigations because soil samples cannot be obtained from discrete depth intervals. Soil samples from solid stem auger borings are typically collected from the surface of the auger flights as the cuttings are brought to the ground surface.

Slotted, hollow-stemmed augers are commonly used in environmental investigations when vertical profiling of a water-bearing unit is desired. The slotted lead auger is advanced to a pre-determined depth below the groundwater table, and water within the auger is purged with a pump to draw "undisturbed" formation water into the auger. A sample of the groundwater is obtained for analysis and the auger is advanced to the next groundwater-sampling interval.

2.3 Borehole Stabilization

2.3.1 Casing

Driving steel pipe or casing provided the most reliable and practical method of advancing a borehole to the required depth. Table 1 summarizes the numerous sizes and types of casing available. The borehole is advance by constant blows of a drive hammer (typically 300 pounds, falling over a distance of 24 inches) upon a drive head, which is attached to the casing. As the blows to drive the casing are constant, supplementary information may be obtained in the soil resistance by counting the casing blows and the resulting penetration. Casing blows are typically recorded for each foot of penetration of the casing. The casing can also be spun and pushed to the desired depth.

The casing is driven/spun in five-foot increments, with representative soil samples being obtained on a continuous basis or at the completion of each five-foot drive (depending upon the project specifications). After the casing is seated at the required depth, the borehole must be cleaned-out prior to obtaining a soil sample. In soft or loose soils, stability of the borehole is increased by keeping the casing filled with water or drilling fluids.

2.3.2 Drilling Mud

Drilling mud is a fluid employed to stabilize an encased borehole, or to improve sample quality and minimize soil disturbance in cased holes. Drilling mud may be prepared from commercially available products. Employing mud in a boring makes identification of the cuttings more difficult and hinders groundwater level observations.

The use of drilling mud is typically avoided when conducting environmental investigations. The use of drilling mud can reduce the permeability of the walls of the borehole, and therefore, lead to erroneous water level measurements. Additionally, the use of drilling mud introduces foreign material to the subsurface environment, which is not completely removed upon completion of the boring. The results of chemical analyses conducted on soil samples from boreholes advanced with drilling mud may not be representative of the natural (undisturbed) formation. Water samples obtained from wells installed in these boreholes may contain contaminants or parameters, which were not originally present in the groundwater prior to the use of the drilling mud.

Under no circumstances, should drilling mud be prepared with local or on-site clays. If the use of drilling mud is required to advance the boring, the mud should be prepared with commercially available clays, and samples of the mud mixture should be collected for potential analysis if needed.

The basic mud mixture employed in the drilling industry is bentonite and fresh water (approximately 6 percent bentonite by weight: 50 pounds of bentonite per 100 gallons of water). Attapulgite clay is commonly used and will mix with salt water to prevent flocculation. Weight additives such as pulverized barite, hematite, galena, or other heavy minerals may be added to the mixture to increase the specific gravity in troublesome soils or under artesian conditions. The precise ingredients and their proportions in the mixture must be recorded for future reference, particularly when groundwater from wells installed in their borings is to be tested for dissolved metals and pH. Attention must be given to the particular group of contaminants exceed to be present in the groundwater beneath the site.

2.3.3 Hollow-stemmed Augers

Hollow-stemmed augers are advanced hydraulically into the overburden to the required sampling depth. The auger acts as a casing during the advancement of the borehole. A removable center plug allows passage of the sampling equipment (typically a split-spoon sampler or Shelby tube) to the required depth. Augers are usually in five-foot sections. Some disturbances of the sampling zone may be created during the augering operation.

Drillers commonly dislike using the center plug and often attempt to complete the boring without using one. However, the center plug should always be used to prevent soil from entering the auger. If a center plug is not used, the split-spoon sampler may not be located at the desired sampling depth due to the presence of soil inside the auger.

2.4 Borehole Cleaning

Thorough and careful cleaning of the borehole is mandatory for obtaining representative, undisturbed samples. Careful measurement of tool length is required. The washing operation should not usually extend below the bottom of the casing (cohesive soils would be an exception). Special bits that deflect the wash water outward or upward should be employed, and only enough wash water should be pumped down the hole to bring the cuttings to the surface. Special shielded auger cleanouts should be employed in cohesive soils prior to obtaining undisturbed piston samples.

Where details of subsurface conditions are necessary, soil sampling shall be conducted using a split-spoon penetration sampler, driven with a 140-pound hammer with a free-fall of 30 inches. This is a standard method of soil sampling as described in ASTM Designation D 1586. If necessary, the length of the hammer shaft will be measured and marked, to ensure a minimum drop of 30 inches. This technique should be conducted as follows:

1. The split-spoon sampler (spoon) consists of a 2-inch (outside diameter) by1-3/8 inch (inside diameter), 18-inch to 24-inch length, heat-treated, case-hardened steel head, split-spoon, and shoe assembly. Split-spoon or split-tube samplers are the most generally accepted method for obtaining representative soil samples (refer to Figure 1), however, from a geotechnical perspective, the samples obtained using a split-spoon are disturbed and unsatisfactory for some analyses.

The head is vented to prevent pressure buildup during sampling and must be kept clean. A steel ball check valve is located in the head to prevent downward water pressure from acting on the sample. Removal of the check frequently causes sample loss.

2. The drive rods, which connect the spoon to the drive head, should have stiffness equal to or greater than that of the A-rod. In order to maintain only minimal rod deflection, on exceptionally deep holes, it may be preferable to use N-rods. The size of the drive rods must be kept constant throughout a specific exploration program, as the energy absorbed by the rods will vary with the size and weight of the rod employed. This is most important in geotechnical investigation

3. The drive head consists of a guide rod to give the drop hammer (140 pounds) free fall in order to strike the anvil attached to the lower end of the assembly. The guide rod must be at least 3.5 feet in length to insure the correct hammer drop.

4. The drop hammer used in determining SPT resistance must weigh 140 pounds and have a 2.5 inch diameter hole through the center, for passage of the drive head guide rod.

5. The hammer is raised with a rope activated by the drill rig cathead; no more than 2 turns of the rope should be allowed on the cathead. A 30 inch hammer drop is mandatory for proper SPT determination. Extreme care must be exercised to produce consistent results.

   Automatic trip hammers are commercially available which insure the 30 inch free-fall drop. When presentation of the soil structure is critical (such as in liquefaction studies), the automatic trip hammer should be employed.

6. Attach the split-spoon sampler to the drill rods and lower the assembly to the bottom of the borehole.

   Measure the drill rod stickup to determine if heave or blow-up of the stratum has occurred. Note any penetration of the sampler into the stratum under the weight of the rods. The 140-pound hammer is raised 30 inches above the drivehead anvil and then allowed to free fall and strike the anvil. This procedure is repeated until the sampler has penetrated the full length of the sampler (18 to 24 inches depending on the sampler) into the stratum at the bottom of the borehole.

7. The number of blows of the hammer required for each 6 inch penetration is counted and recorded on the test boring log. A penetration rate of 100 blows per foot is normally

considered refusal; however, this criterion may be varied depending upon the desired information. The penetration resistance (N) is determined by adding the second and third 6-inch resistance blow counts together. When other sizes and types of sampling and drive equipment are employed, ASTM reference tables may be used in converting the obtained blow count to the accepted SPT value.

8. The sampler is then withdrawn from the borehole, preferably by pulling on the rope. If the sampler is difficult to remove from the stratum, it may be necessary to remove it by hitting the drive head upward with short, light hammer strokes. Remove the sampler from the bottom of the borehole slowly to minimize disturbance. Keep the casing full of water during the removal operation.

9. Careful measurement of all drilling tools, samplers, and casing must be exercised during all phases of the test boring operations, to insure maximum quality and recovery of the sample.

10. The split-spoon is opened and carefully examined, noting all soil characteristics, color seam, disturbance, etc. A representative sample is selected and preserved in a screw-top, glass jar and properly labeled. In the event that more than one soil type is encountered in the split-spoon, each soil type should be preserved in a separate jar.

11. The supervising geologist/engineer shall record, at a minimum, the weight of the hammer, the length of the split spoon sampler, and the number of hammer blows on the spoon per 6 inches of penetration. Upon removal of the sampler, the earth materials shall be logged in accordance with SOP No. 005, Soil Sample Description.

    When the number of blow counts exceeds 50 per 6 inches, the split spoon sampling shall be terminated and the number of blow per tenths of foot (for the last one-half foot) shall be recorded and noted as sampler refusal.

12. If a sample is to be retained, a pre-cleaned stainless steel or teflon coated spoon will be used to take the soil sample and fill the sample containers.

13. After the samples have been collected and if a well is not being installed in the boring, the borehole should backfilled with cement/bentonite or cement, the approximate location of the boring will be marked with an oak stake colored with highly visible spray paint. The boring number will also be written on the stake to identify the sample location for surveying purposes.

2.5 Logging Bedrock Cores

Rock Coring is a method to obtain bedrock samples for geologic classification, facilitate their performance of permeability tests, and install groundwater monitoring wells within bedrock formations.

The supervising geologist/engineer on a drilling program is responsible for logging and recording geologic and geotechnical information from rock cores.

There is no universal core barrel or drilling equipment for rock coring. The geologic and topographic conditions, in addition to the requirements of the project will dictate the type of equipment to be employed on any specific project. The following factors lead to good production:

1. Insure a level and stable drilling platform before commencing boring.

2. Insure that the drill stem remains as nearly vertical as possible. On deep core holes, true alignment of the casing is critical. The driller may elect to use a heavy drilling mud instead of casing to support the borehole walls; this procedure is not acceptable for environmental investigations.

3. Upon encountering boring refusal at the soil/bedrock interface, the casing should be firmly seated on the rock and thoroughly washed out before inserting the diamond-bit core barrel.

4. Inspect the selected core barrel and bit for wear, general cleanliness, and free movement of all parts. Reject any core barrel or bit that appears unsatisfactory. Upon selecting a satisfactory core barrel and bit, mount the core barrel and bit assembly on the drilling rods and lower it into the borehole until the bit touches the bedrock surface.

5. Pump drill fluid down the drill rods and observe a return flow before commencing drilling operations.

6. Carefully measure all length of rods, core barrel, and stick-up through all phases of the drilling to insure accurate depth determination.

7. The diamond-bit core barrel should be started in the hole and the rock drilled in continuous 5-foot length intervals (runs) until the required depth is reached.

8. Drill with minimal vertical pressure and rotation. Most rigs are equipped with a selection of gear ratios and a variable hydraulically-controlled feed mechanism. Driller expertise in selecting the correct combination of speed and feed rate is invaluable.

9. Water return should be no more than what is just sufficient to bring the borehole cuttings to the surface.

10. Record the drilling time per foot, type of bit, estimate of bit wear, drill rig R.P.M., and feed pressure.

11. Upon completing each 5 foot core run, the core barrel is spun and lifted to break the core at the bottom of the run. After the core is broken off it should be withdrawn, labeled, and stored in an approved core box. Cores should be carefully handled to ensure their proper identification and placement in correct order. Care should be taken to recover as large a percentage of unbroken core as possible.

12. Carefully place the rock core in the core box with wooden partitions so that the cores from each boring will be kept separate. The core should always be placed in the core box in book fashion with the top of the run at the upper left corner and the remaining core placed sequentially from left to right and from the top left corner to the lower right corner. Place a wooden partition at the beginning and end of each core run. The core should fit snugly in the box so that it will not roll or slide and suffer additional breakage. The wooden blocks should be labeled with the Run Number and depths of the beginning and end if each run.

    Each core box should only contain cores from a single boring. Never place the core from more than one test boring in a core box. In addition, wherever core is lost due to the presence of a cavity or large discontinuity (open or filled), a spacer should be placed in the proper position in the core box. The spacer should be labeled with the depth range and thickness of the missing core, and the reason for the missing core (e.g., cavity, large joint, etc.).

13. Carefully examine and classify the rock, and measure the recovery and RQD in percent. Record all information on the core boring report.

14. If 100% recovery was not obtained, sound the borehole to determine if the missing core still remains in the bottom of the borehole.

15. Always terminate each boring with 100% recovery, in order to insure that appropriate knowledge is available of their materials.

16. The core box should be marked on the top and two ends with the client's name, site identification, boring number, depth range, and box number.

17. The core barrel and drilling tools must be steam-cleaned or washed upon completion of the bore hole to preclude cross contamination between successive bore holes.

18. Wash water used during the core drilling should not be re-circulated to the bore hole if possible.

2.5.1 Wireline Drilling

The procedures for wireline drilling are also the same as for conventional rock coring, with the exception that the core barrel is designed so that the inner core barrel can be raised in a wireline without removing the entire drill string, outer core barrel, and bit. The drilling rig must be equipped with a wireline hoist.

2.5.2 Oriented Core

If precise spatial orientation of rock bedding, foliation, and discontinuities are required, it is recommended that the Christensen Diamond Products Series D-3, NWD-3 core barrel, or equivalent, be employed.

2.5.3 Shotcore Drilling

Shotcore drilling is usually employed to produce large-diameter rock core (2 to 6 feet and larger). The core is cut by the abrasive action of chilled steel shot fed to a rotating steel bit. Shotcoring procedures are as follows:

1. Lower the assembled shotcore barrel to the bedrock surface.

2. Drop one or two handfuls of chilled shot down the center rod. Connect the bit to the drilling spindle and slowly turn by hand with a pipe wrench. A gritty feeling indicates that the shot is beneath the bit.

3. Lift the bit off the bottom and introduce the fresh water supply. When water return appears at the surface, lower the bit to the bedrock surface.

4. Drill feed must be manual with only enough downward pressure to follow the bit. This is an abrasive action and too much shot will wear the core barrel and too little will not core the rock. Driller expertise and careful attention are absolutely critical in successful shotcore drilling.

5. Regulate water flow so that it just allows the cuttings and slivers of steel to be carried over the top of the casing. Add additional shot as required.

6. A good flow of muddy slurry to the surface indicates that the rock is being drilled.

7. If water return is clear, but contains fine particles of steel, this is an indication that an excess of shot has been used. Flush the hole and start again.

8. Record the drilling rate and reface the bit shoe after every withdrawal by squaring up the face with a hammer.

9. To recover the core, a hard, uniformly-graded pea gravel is fed into the center rod as it is slowly rotated so the gravel is grouted between the core and the core barrel, and the entire unit is pulled to the surface. On occasion, it may be necessary to remove the core barrel and drill a small diameter hole in the center of the core while it is still in the hole, and then drive a casing retriever into the core before retrieval is possible.

2.5.4 Preservation of Rockcore

The following information shall be included in a rock core run log:

- The depth and length of the core run.
- The coring rate, down pressure, and torque and rotation speed. This information can be obtained from the driller.
- The color of the core wash water. Any changes, loss of return water, or gain of return water will be noted.
- The recovery of the core run recorded as length of rock recovered over the length of the core run.
- The Rock Quality Designation (RQD) of the run. RQD is reported as the sum of inches of all naturally fractured rock core pieces larger than four inches over the total number

of inches in the run. The length of the piece will be determined by the distance between naturally occurring fractures.

- The rock type(s) and their location in the core run, rotating color, mineralogy, texture, fossil content, effervescence in HCL, and any other data of geologic significance.

- Any structure in the core, including fractures, clay seams, vugs, bedding, fissility, and any other data of geologic or geotechnical significance.

Rock cores shall be stored in a core box in the exact sequence in which they were removed from the ground. Core runs will be separated by wooden blocks clearly marked with the depth of the run. The top of the core box shall be marked with the project name, location, project number, boring number, and the depths of the core runs in that box. The front and one end of the core box shall be marked with project name, boring number, and depths of the core runs in that box. All core pieces shall be oriented in the box as they fit together. A black and white stripe shall be drawn down the length of the core, so that core orientation can easily be determined.

2.6 Photographing Soil and Rock Samples from Borings

If soil samples are to be photographed this should occur while still in the split spoon. If smearing of the sample has occurred, a fresh exposure can be made by scraping with a pen knife or other similar object. The spoon and sample should be placed in a good light, preferably against a solid colored background. A ruler for scale and a tag identifying the sample should be placed in the picture. The identifier tag must have the sample number, depth and project name or number written so as to be legible in the photograph. Any photographs taken must be recorded in the field logbook.

Rock core samples are photographed in the wooden core box. The rock should be wetted to enhance the color and textural changes in the rock. Due to the relatively large size of most core boxes, the photographer (when possible) should stand up on a chair, tail gate, car bumper or other perch in order to photograph the box from directly above, and get the entire box in the camera's field of view. The photograph must include a ruler for scale and an identifier tag indicating the project name and number, the boring number, the date, and the depths of the various core runs.

STANDARD OPERATING PROCEDURE NO. 240

DIRECT PUSH SOIL SAMPLING

Prepared by:_____ Date:_____

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 240

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STANDARD OPERATING PROCEDURE NO. 240
DIRECT PUSH SOIL SAMPLING

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for conducting direct push technology (DPT) soil sampling activities.

This SOP will be implemented in accordance with the following governing documents:

- RI/FS Work Plan, which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RI/FS;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of DPT soil sampling is to collect subsurface soil samples at depth-discrete intervals.

2. EQUIPMENT

A DPT rig will be used to conduct subsurface soil sampling activities. The DPT (Geoprobe®, PowerProbe™ or similar) device may be operated using a dual tube methodology which allows the collection of subsurface soil samples through an outer casing that is set to maintain the integrity of the boring. Using the DPT rig, borings are advanced by simultaneously driving an outer stainless steel casing and disposable inner Lexan® tube into the ground. Upon reaching the desired penetration depth, the inner Lexan® tube is extracted to collect the discrete subsurface soil samples, leaving the outer casing in place. To sample the next interval of soil, a new length of Lexan® tubing is then inserted into the outer casing (already in the ground) attached to a length of drive pipe, and another length of outer casing is attached to the top of the outer casing that is already in the ground. The following materials should be available, as required, during the subsurface soil sampling:

- equipment necessary for surface soil sampling (see SOP 200);
- Personal Protective Equipment (PPE) and air monitoring equipment as required by the HASP;
- DPT sampling equipment;
- decontamination equipment per the QAPP and FSP;
- measuring device;
- photoionization detector (PID);
- camera; and
- field log book and forms as specified in other SOPs.

3. PROCEDURES

The following procedures will be employed to collect subsurface soil samples:

1. Ensure that all drilling sites are safe by carrying out appropriate subsurface utility clearance.
2. Don the appropriate PPE and begin air monitoring as specified in the HASP.
3. Set-up an equipment cleaning station, and decontaminate reusable equipment as described in the FSP. Use new, clean, disposable materials when decontamination is not appropriate (e.g., disposable gloves, sampling tubes, and dedicated drive points).
4. Assemble the dual probe (outer steel casing and inner Lexan® tube) sampling apparatus or other DPT tool.
5. Drive the sampling tools to the appropriate sampling zone.
6. When the desired depth for the collection of a subsurface soil sample is reached, retrieve the inner Lexan® tube and segregate the soil sample, as needed. If an alternative DPT tool is used, push to the appropriate depth and sample following the equipment operations instructions.
7. Note the soil type, color, odor, amount of recovery, and screen the soil core for volatile organic compound (VOC) analysis using the photo-ionization detector (PID). All field data shall be recorded in the soil sample sheet (see SOP No. 200.) Sample soils for laboratory analysis per requirements of the FSP and instruction in the SOP No. 200 for Soil Sampling. In some cases, depending upon FSP requirements, PID field screening will be used to select intervals for sampling.
8. Decontaminate non-disposable equipment or tools that may have come into contact with subsurface soil (refer to FSP or QAPP.)
9. Discard all disposable equipment used during sampling activities in a designated location.
10. Abandon the borehole with bentonite pellets; hydration is not necessary.
11. If the DPT is used for drilling more than 4 ft, documentation will switch to a drilling log (see SOP No. 230 for rock and soil borings).

STANDARD OPERATING PROCEDURE NO. 410

PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

Prepared by:_____ Date:_____

Reviewed by:_____ Date:_____

Approved by:_____ Date:_____

SOP No. 410

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STANDARD OPERATING PROCEDURE NO. 410
PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to establish packaging and shipping requirements and guidelines for environmental sample shipping. Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis.

This SOP will be implemented in accordance with the following governing documents:

- RI/FS Work Plan, which provides an overview of the site background and conceptual model and describes the overall investigative goals and scope of work for the RI/FS;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Field Sampling Plan (FSP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The purpose of appropriate packaging and shipping for environmental samples is to protect the integrity of environmental samples shipped for analysis and to ensure that environmental samples arrive at the environmental laboratory in good condition for analysis.

1.3 Equipment

Equipment needed for packaging and shipping of environmental samples includes:

- coolers with return address of site office written on inside lid;
- heavy-duty plastic overbags, cooler-size;
- plastic zip-top bags, small and large;
- plastic packing tape;
- duct tape;
- bubble wrap;
- ice;
- chain-of-custody seals;
- completed Chain-of-Custody Record;
- completed bill of lading or airbill.

The term "Environmental Sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172.

2. PROCEDURES

The following steps must be followed when packing for shipment by air:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug (inside and outside) with duct tape.
2. Be sure the caps on all bottles are tight (will not leak); check to see that labels/tags and Chain-of-Custody Records are completed properly.
3. Double-bag ice in large plastic zip-top bags and properly seal.
4. Place all bottles in separate and appropriately-sized plastic zip-top bags and close the bags. Up to three volatile organic compound (VOC) vials may be packed in one bubblewrap envelope placed inside a zip-top bag; alternatively, nine VOC vials may be packed in a foam cube with vial slots, with the cube packed in a zip-top bag. Glass bottles should be wrapped in bubble wrap before placing in zip-top bags.

5. Place two to four inches of packing peanuts or vermiculite into the bottom of the cooler. Alternatively, place two layers of large-bubble bubble wrap on the bottom of the cooler.
6. Place a clear, cooler-size overwrap bag in the cooler, place one layer of ice and a temperature blank in the bottom of the bag, and then place the bottles in the bag with sufficient space to allow for the addition of a second layer of ice bags over the sample containers. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather then horizontally.
7. Place the second layer of ice bags on top of the samples. Close and securely fasten the top of the large overbag with tape (preferably duct tape).
8. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.
9. Packing tape shall be wrapped around each end of the cooler two times, and completed Chain-of-Custody seals affixed to the top opposite sides of the cooler half on the tape so that the cooler cannot be opened without breaking the seal. Wrap clear tape over custody seals.
10. The shipping containers must be marked with THIS END UP, and arrow labels, which indicate the proper upward position of the container, should be affixed to the cooler. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

APPENDIX E

Quality Assurance Project Plan (QAPP)